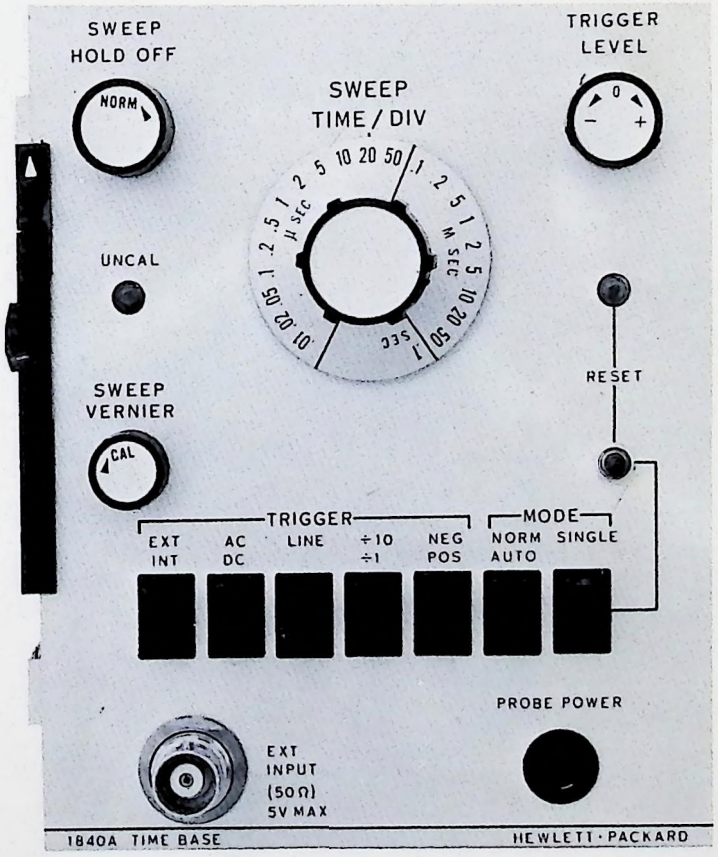
OPERATING AND SERVICE MANUAL

# TIME BASE
## 1840A




HEWLETT hp PACKARD

HP1840A

## CERTIFICATION

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## WARRANTY AND ASSISTANCE

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OPERATING AND SERVICE MANUAL

# MODEL 1840A
# TIME BASE

**SERIALS PREFIXED: 963–**

Refer to Section VII for instruments with other Serial Prefixes.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

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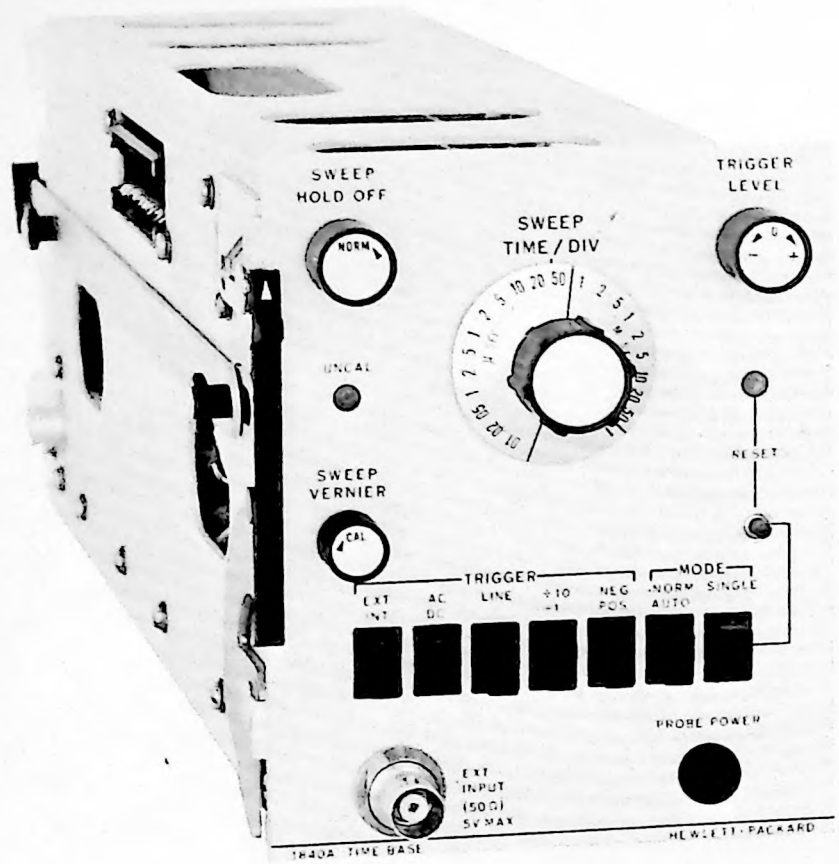



Figure 1-1. Model 1840A Time Base

Table 1-1. Model 1840A Specifications

## SWEEP

RANGES: from 10 ns/div to 0.1 sec/div in 1, 2, 5 sequence; ±3% accuracy with vernier in calibrated position. Mainframe magnifier extends fastest speed to 1 ns/div with ±5% accuracy.

VERNIER: continuously variable between all ranges, extends slowest sweep to at least 0.25 sec/div.

## TRIGGERING

NORMAL:

Internal: dc to >250 MHz with 1830A plug-in and signals producing 1.0 div or more vertical deflection.

External: dc to >250 MHz with signals of 20 mV pk-pk or more, increasing to 50 mV at 500 MHz. Input impedance 50 ohms. ÷ 10 trigger attenuator allows wider dynamic ranges of INT and EXT trigger input.

AUTOMATIC: bright baseline displayed in absence of trigger signal. Triggering is same as normal except low frequency limit is 5 Hz for internal and external triggering.

SINGLE SWEEP: selectable with front-panel switch; reset pushbutton with armed indicator light. Rear-panel input provides remote arming.

TRIGGER LEVEL AND SLOPE:

Internal: any point on the vertical waveform displayed.

External: trigger level continuously variable from +0.1V to −0.1V on either slope of sync signal; from +1.0V to −1.0V in ÷ 10 setting.

COUPLING: front-panel selection of ac or dc. AC attenuates signals below approximately 5 kHz.

VARIABLE HOLD OFF: time between sweeps continuously variable, exceeding one full sweep on all ranges.

## GENERAL

WEIGHT: net, 3 lb (1,4 kg); shipping 6 lb (2,7 kg).

# SECTION I

# GENERAL INFORMATION

## 1-1. INSTRUMENT DESCRIPTION.

1-2. The Hewlett-Packard Model 1840A Time Base (shown in Figure 1-1) is a linear sweep generating plug-in unit for The HP Model 183A/B Oscilloscope. Twenty-two ranges provide calibrated sweep speeds from 0.01 usec/div to 0.1 sec/div in a 1, 2, 5 sequence. Also the slowest sweep range can be extended beyond 0.25 sec/div and sweep speeds in between ranges can be continuously varied with a vernier control. The fastest sweep speed can be expanded to 1 ns/div with the X10 horizontal magnifier on the HP Model 183A/B Oscilloscope.

1-3. The sweep can be triggered by an internal signal generated in the vertical plug-in, or by an external signal input up to 500 MHz. Front-panel controls allow adjustment of sweep hold-off time, and trigger level, and selection of slope, coupling, and sweep speeds. By operating the instrument in automatic sweep mode, a bright base line is present in the absence of a trigger signal. The single sweep mode permits transient waveform photography. Variable sweep hold off allows more stable viewing of repetitive complex waveforms. Refer to Table 1-1 for listing of complete specifications.

## 1-4. SCOPE OF MANUAL.

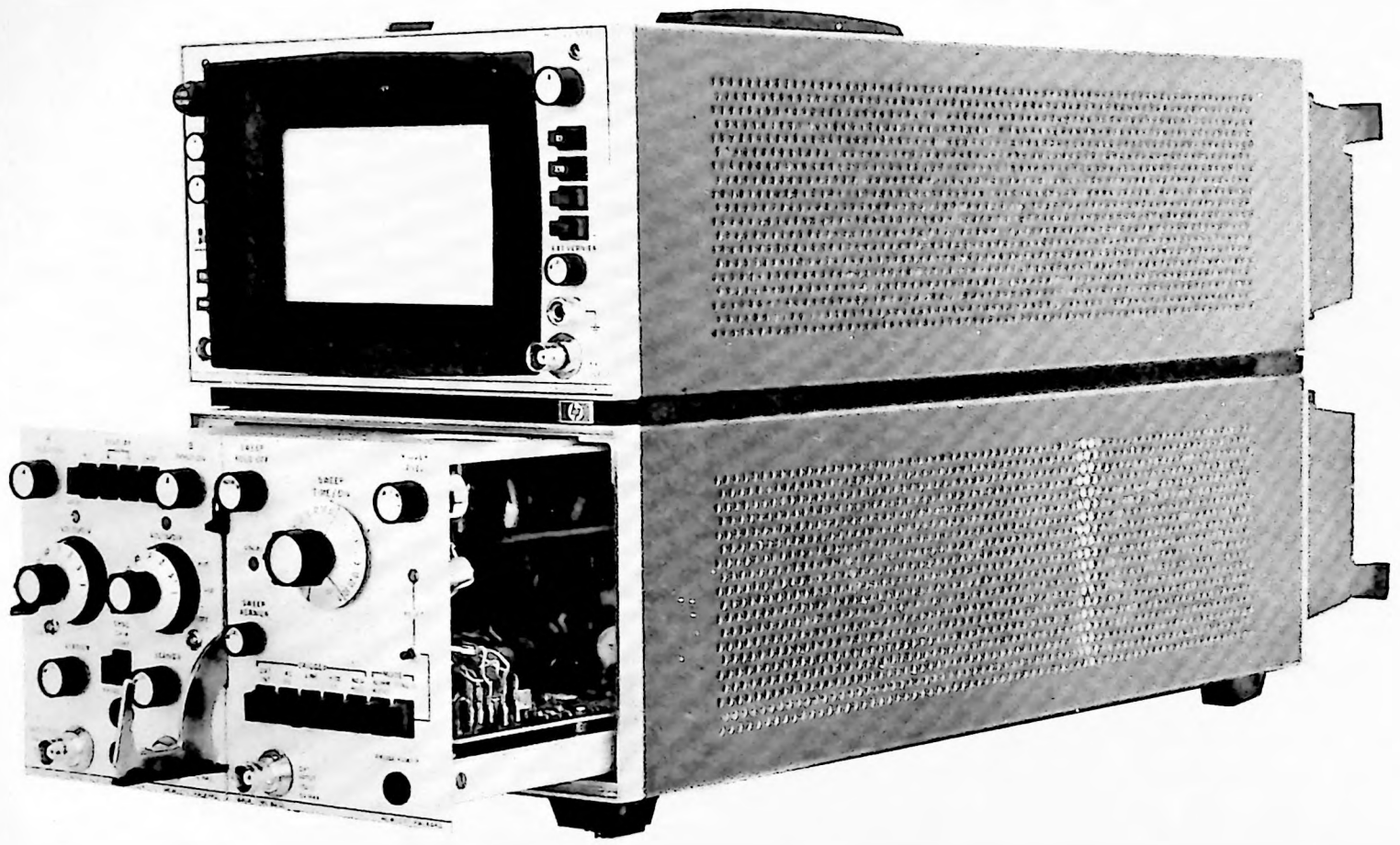
1-5. This manual provides operating and service information for the HP Model 1840A Time Base generator. It supplements the information presented in the operating and service manual for the HP Model 183A/B Oscilloscope. For specific information on other HP Model 183A/B plug-ins, refer to the manual for that specific plug-in.

## 1-6. INSTRUMENT IDENTIFICATION.

1-7. Hewlett-Packard uses a two-section, eight-digit serial number to identify instruments. The first three digits (preceding the dash) of the serial prefix identifies a specific series of instruments; the last five digits identify a particular instrument within that series. The serial number appears on a plate located on the rear panel. All correspondence with Hewlett-Packard in regard to an instrument should refer to the model number and complete serial number.

## 1-8. MANUAL CHANGES.

1-9. This manual provides complete information for any HP Model 1840A with a serial number prefixed by the three digits indicated on the title page (paragraph 1-6). If the serial prefix of the instrument is different from that on the title page, a yellow MANUAL CHANGES insert sheet supplied, or Section VII of this manual, will describe the changes required to adapt this manual to provide correct coverage. Technical corrections (if any) to this manual due to known errors in print are called ERRATA and are shown on the MANUAL CHANGES sheet. For information on manual coverage of any Hewlett-Packard instrument, contact the nearest Hewlett-Packard Sales/Service Office (addresses are listed at the rear of this manual).



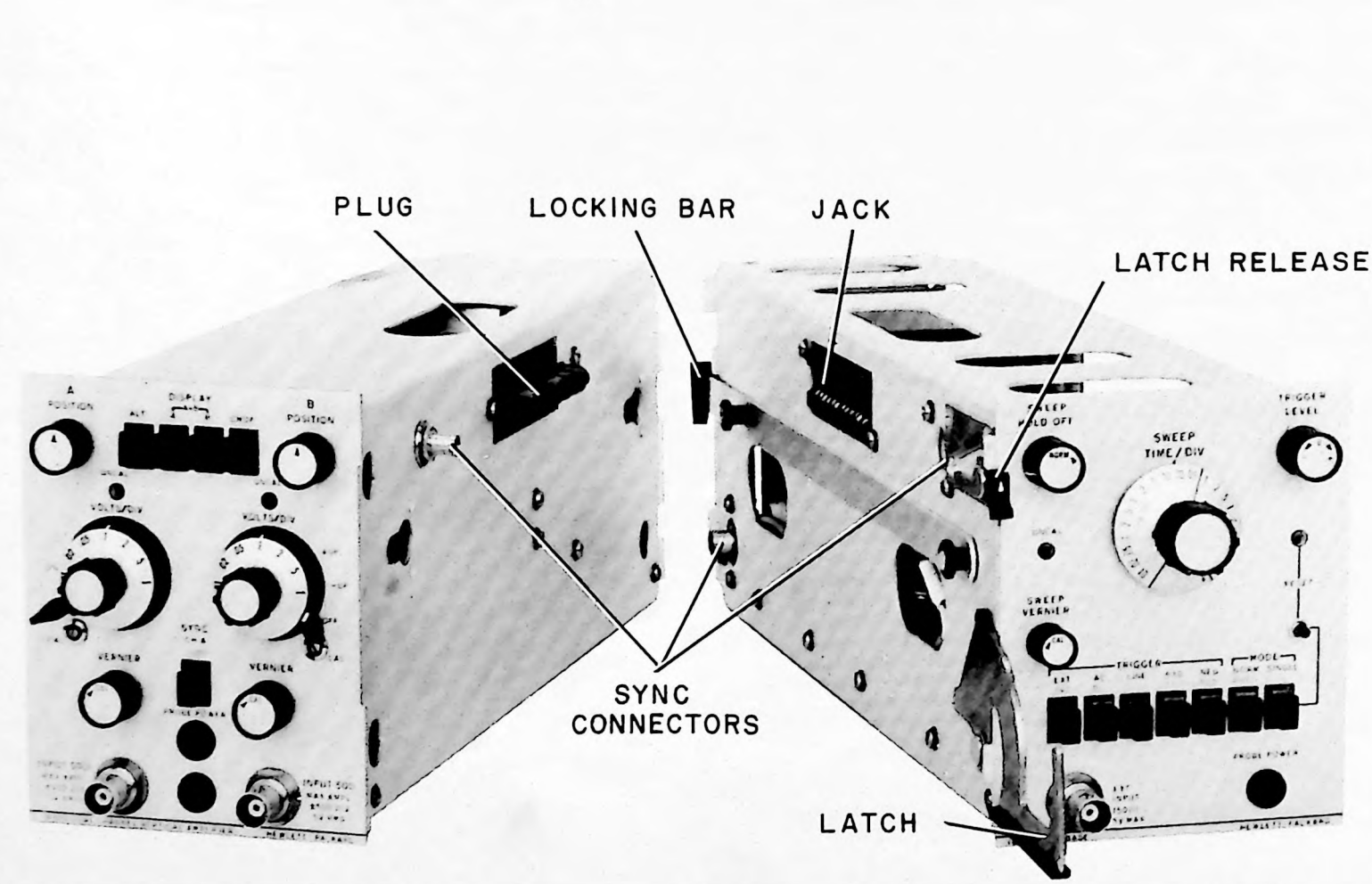



Figure 2-1. Plug-in Mating

# SECTION II

# INSTALLATION

## 2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. Check the shipping carton for damage immediately after receipt. If it is damaged, ask the carrier's agent to be present when the instrument is unpacked. Inspect the Model 1840A for physical damage such as bent or broken parts and dents or scratches. If damage is found, refer to Paragraph 2-4 for the recommended claim procedure. If the Model 1840A appears undamaged, perform the electrical check (Paragraph 2-3). Retain the packaging material for possible future use.

2-3. ELECTRICAL CHECK. The performance check is given in Section V. This Check will determine whether or not the instrument is operating within its specification as listed in Section I. The initial performance and accuracy of this instrument are certified as stated on the inside front cover of this manual. If the Model 1840A does not operate as specified refer to Paragraph 2-4 for the recommended claim procedure.

## 2-4. CLAIMS.

2-5. If physical damage is found or if the instrument does not operate within specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for the repair or replacement for the instrument without waiting for a claim to be settled with the carrier.

2-6. The warranty statement for all Hewlett-Packard products is on the inside front cover of this manual. Contact the nearest Sales/ Service Office for information about warranty claims.

## 2-7. REPACKAGING FOR SHIPMENT.

2-8. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office attach a tag to it showing owner's name and address, instrument's model number and eight-digit serial number, and a description of the services required.

2-9. The original shipping carton and packaging materials should be used for reshipment. If they are not available or reusable, the instrument should be repackaged with the following materials:

a. double-walled carton (refer to Table 2-1 for test strength required).

b. heavy paper or sheets of cardboard to protect all instrument surfaces (use a nonabrasive material such as polyurethane or a cushioned paper such as Kimpak around all projection parts.

c. at least 4 inches of tightly-packed, industry-approved, shock-absorbing material, such as extra-firm polyurethane foam.

d. heavy-duty shipping tape to secure outside of carton.

Table 2-1. Shipping Carton Test Strengths

| Gross Weight (lbs) | Carton Strength (test lbs) |
|---|---|
| up to 10 | 200 |
| 10 to 30 | 275 |
| 30 to 120 | 350 |
| 120 to 140 | 500 |
| 140 to 160 | 600 |

## 2-10. PREPARATION FOR USE.

2-11. The Model 1840A and the vertical plug-in are locked together and inserted as a unit into the plug-in compartment of the Model 183-series Oscilloscope. This procedure is explained below. Power for the Model 1840A is supplied by the Oscilloscope.

2-12. Install plug-ins as follows:

a. Move locking bar to rear (Figure 2-1).

b. Fit vertical plug into horizontal jack (make certain that bulkhead connectors are aligned) and press plug-ins firmly together.

c. After ensuring that front and rear panels are aligned, push locking bar forward.

d. Rotate plug-in latch downward and insert plug-ins into the Model 183-series Oscilloscope.

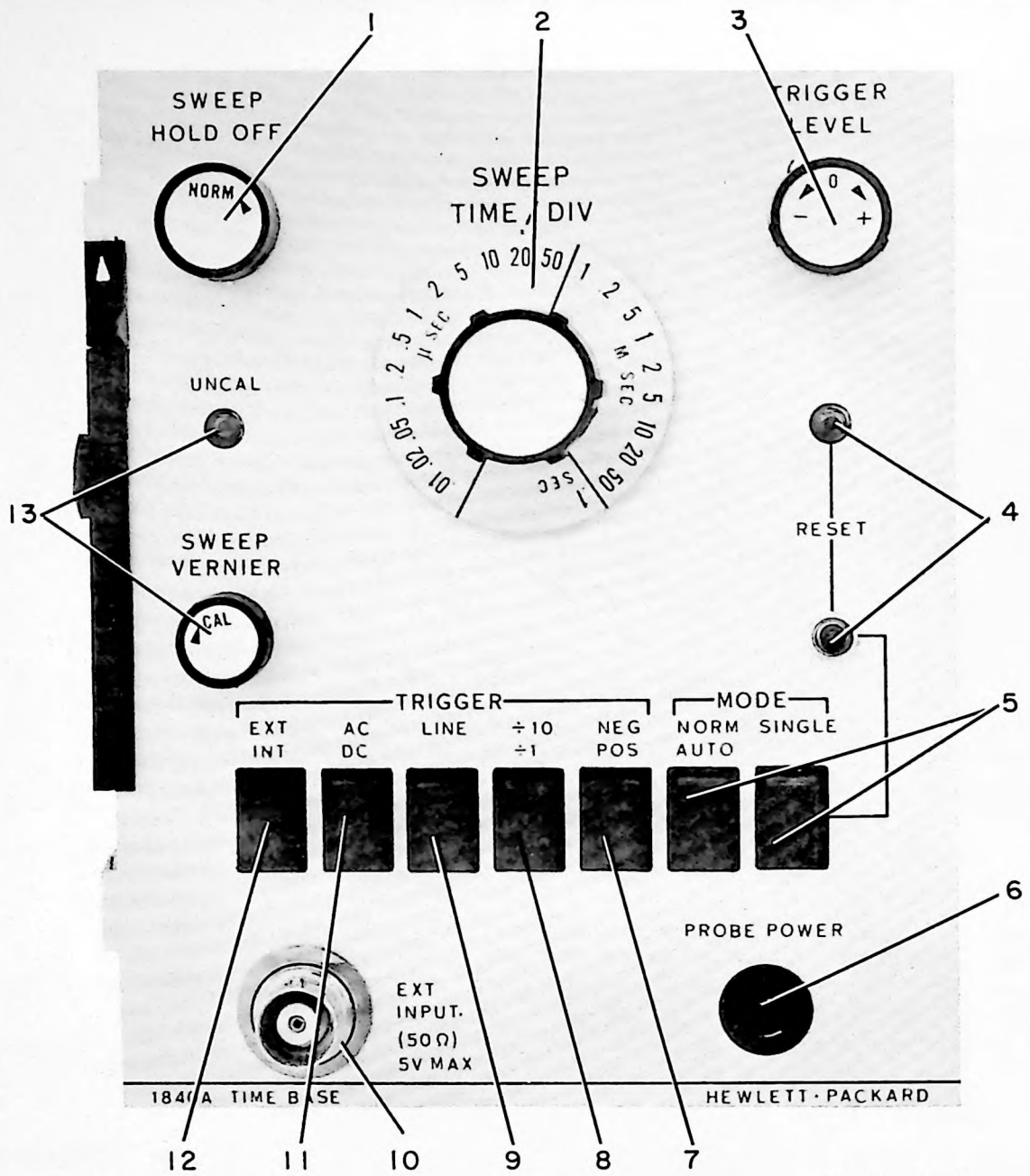
e. Rotate plug-in latch upward and push forward to lock.

## 2-13. INSTRUMENT COMPATIBILITY.

2-14. The HP Model 1840A Time Base can be used with all HP Model 1800-series Vertical Amplifier plug-ins. However, the HP Model 1840A can be used in the HP Model 183A/B Oscilloscope mainframe only. When using Vertical Amplifiers other than HP Model 1830A, slight electrical changes may be required. Refer to the manual for the specific instrument concerning instrument compatibility.

NOTE

The HP Model 1840A has a mechanical lockout to prevent use in a mainframe other than HP Model 183A/B. The HP Model 1840A requires a +35—volt supply which is not available in mainframes other than HP Model 183A/B.




1840A — A — 1

1. SWEEP HOLD OFF. Varies hold-off time between the end of one sweep and the beginning of the next.
2. SWEEP TIME/DIV. Selects the time represented by each division on the horizontal axis of the CRT.
3. TRIGGER LEVEL. Selects the point on the TRIGGER waveform that triggers the sweep.
4. RESET. The pushbutton switch arms the sweep circuit in the SINGLE MODE. The indicator lights when the sweep circuit is armed.
5. SWEEP MODE. Selects a sweep that is triggered by the incoming signal (NORM); a sweep that is either triggered by the incoming signal, or is free running (to provide a baseline) in the absence of an incoming signal (AUTO); or a sweep that is triggered only once and must be manually rearmed (SINGLE).
6. PROBE POWER. Connector to supply +15 volts, −12.6 volts, and ground to active probe (if used).
7. TRIGGER slope. Selects the signal slope that triggers the sweep.
8. TRIGGER division factor. Determines the division factor ÷1 (1:1), or ÷10 (10:1).
9. TRIGGER source. Selects power line (LINE) signal obtained from power transformer for triggering or the signal selected by the EXT/INT switch.
10. EXT INPUT. BNC connector for applying an external trigger signal. It is a 50-ohm input with a 5-volt rms (0.5-watt) maximum input signal rating.
11. TRIGGER Coupling. Selects direct coupling (DC) or capacitive coupling (AC).
12. TRIGGER Source. Selects either external (EXT) or internal (INT) signal sources for triggering the sweep.
13. SWEEP VERNIER. Provides continuous variation between calibrated positions of the TIME/DIV switch. UNCAL lamp lights when sweep time is not calibrated (not fully clockwise).

Figure 3-1. Controls and Connectors

# SECTION III

# OPERATION

## 3-1. INTRODUCTION.

3-2. The Model 1840A Time Base generates linear sweeps for HP 183-series oscilloscopes. Features include NORMAL, AUTO, and SINGLE sweep operation, sync-source selection, level control, and variable hold-off.

## 3-3. CONTROLS AND CONNECTORS.

3-4. Refer to Figure 3-1 for a brief functional description of the front-panel controls and connectors. More details are given in the following paragraphs for some of the controls.

3-5. The pushbutton switches used on the HP Model 1840A are two-position switches. When the switches are in the in position, the black panel markings above the switches determine the function. When the switches are in their out position, a blue ring appears on the pushbutton and the switch function is determined by the blue panel markings above the switches.

3-6. TIME/DIV. Controls the time for 1 division of sweep. Twenty-two ranges provide calibrated sweep speeds from 0.01 usec to 0.1 sec/div. By setting the magnifier control on the 183-series oscilloscopes to X10, the selected sweep time may be decreased by 10 times.

3-7. SWEEP VERNIER. Provides continuous adjustment between the calibrated positions of the SWEEP TIME/DIV switch. With SWEEP VERNIER fully clockwise, the UNCAL lamp will be off and sweep speed can be read directly from the SWEEP TIME/DIV control. Rotating SWEEP VERNIER counterclockwise will turn the UNCAL lamp on and increase sweep time/div until, when fully counterclockwise, the time/div is at least 2.5 times longer than indicated by the SWEEP TIME/DIV switch.

3-8. SWEEP HOLD-OFF. Hold-off is the amount of time between the end of one sweep and the beginning of the next. A sweep will start on the first trigger that occurs after the hold-off time has elapsed on NORMAL, and immediately after the hold-off time has elapsed in AUTO. The SWEEP HOLD-OFF control allows hold-off time to be increased to more than the sweep time on all SWEEP TIME/DIV ranges. This feature allows a stable presentation of repetitive complex waveforms.

3-9. SWEEP MODE. The two pushbutton switches determine the type of sweep operation to be used. In the AUTO position, a bright baseline is presented in the absence of a trigger signal. This is done by free-running the sweep at a rate controlled by the SWEEP TIME/DIV switch. A trigger signal frequency greater than 5 Hz will override the AUTO circuit and synchronize the sweep. In NORMAL, a sweep will be produced with a trigger signal only. NORMAL should be used if the sync signal is less than 5 Hz. SINGLE provides one horizontal sweep which permits photographing transient waveforms. The sweep circuit must be rearmed manually by pressing the reset pushbutton, or electrically by an external input to the rear-panel of the HP 183A/B oscilloscope to trigger another sweep.

3-10. TRIGGER SOURCE. The INT/EXT/LINE switches select the source of the trigger signal. When EXT input is selected, the signal applied to the EXT INPUT triggers the sweep and the INT trigger signal is terminated into 50 ohms. When INT is selected, the signal generated from the vertical amplifier triggers the sweep in the time base and the EXT trigger signal is terminated into 50 ohms in series with 1 microfarad. The trigger source selected can be either applied directly to the sync amplifier or it can be attenuated by a factor of 10. If the ÷ 1 function is used, the maximum trigger level range is ±100 mV peak. If the ÷10 function is used, the maximum trigger level range is ±1 volt peak. The maximum signal that can be applied to the external input of the time base is 5 volts RMS.

3-11. The ÷10 function can be used to attenuate noise on trigger signals. The trigger threshold of the Model 1840A is approximately 3 mV (i.e. the trigger input signal must be greater than 3 mV to generate a sweep). If noise is superimposed on the trigger signal and is less than approximately 25 mV, the ÷10 function will reduce the noise level below the 3 mV threshold level and prevent the noise from triggering the sweep. The noise could otherwise produce a multiple triggering display on the CRT.

3-12. The LINE trigger signal is a 3-volt peak-to-peak ac signal coupled to the TIME BASE from the power transformer of the mainframe. The LINE trigger source switch follows the trigger coupling function switch. If the LINE signal is selected, the trigger signal (INT or EXT) that is coupled to the LINE trigger switch is terminated into 50 ohms.

3-13. TRIGGER COUPLING. The type of trigger coupling is determined by the AC/DC control. Direct coupling (DC) is normally used for trigger signals from dc to 500 MHz. Capacitive coupling (AC) will block the dc component of the trigger signal and also attenuate signals below approximately 5 kHz. The AC coupling can also be used to prevent low frequency noise from triggering the sweep. Also, AC coupling is recommended for frequencies above 10 MHz.

3-14. TRIGGER SLOPE. This switch selects triggering on the positive-going (+) or negative-going (—) portion of the trigger signal.

3-15. TRIGGER LEVEL. The voltage level of the trigger signal which will trigger the sweep is set with the TRIGGER LEVEL control. This voltage, along with a selected slope, will adjust between —100 mV and +100 mV when ÷1 function is used with a selected signal source. In the ÷10 position, the maximum trigger level range is from —1 volt to +1 volt. The trigger level is adjustable with the mode switches in AUTO (triggered), NORMAL, or SINGLE.

## 3-16. TRIGGER SIGNAL REQUIREMENTS.

3-17. Table 3-1 shows the typical trigger signal requirements and front-panel control settings of the HP Model 1840A. Figure 3-2 is used in conjunction with Table 3-1 to determine the typical trigger amplitude necessary at frequencies up to 500 MHz.

## 3-18. OPERATING INSTRUCTIONS.

3-19. Figures 3-3 through 3-6 contain step-by-step operating instructions for the normal operation of the Model 1840A. These instructions are number keyed to the front-panel controls shown in each figure. The preceding paragraphs contain additional information and should be read before operating the instrument.

3-20. The Model 1840A can display signals up to 500 MHz with a maximum sweep time of 1 ns/div using the X10 magnifier of the Model 183A oscilloscope mainframe. Typically signals below 100 MHz will trigger with only 3 mV of external signal; signals between 100 MHz and 250 MHz with only 8 mV of external signal. However if a fast sweep speed is selected in AUTO and a low repetition signal is applied to the Model 1840A, the presentation might not override the AUTO circuit. This apparent mal-triggering can be corrected by switching to NORM operation, obtaining a display, and then switching back to AUTO.

3-21. The trigger signal must make a 20 mV excursion in EXT or 1 div excursion in INT to override the free-run operation. The excursion must occur during the sweep

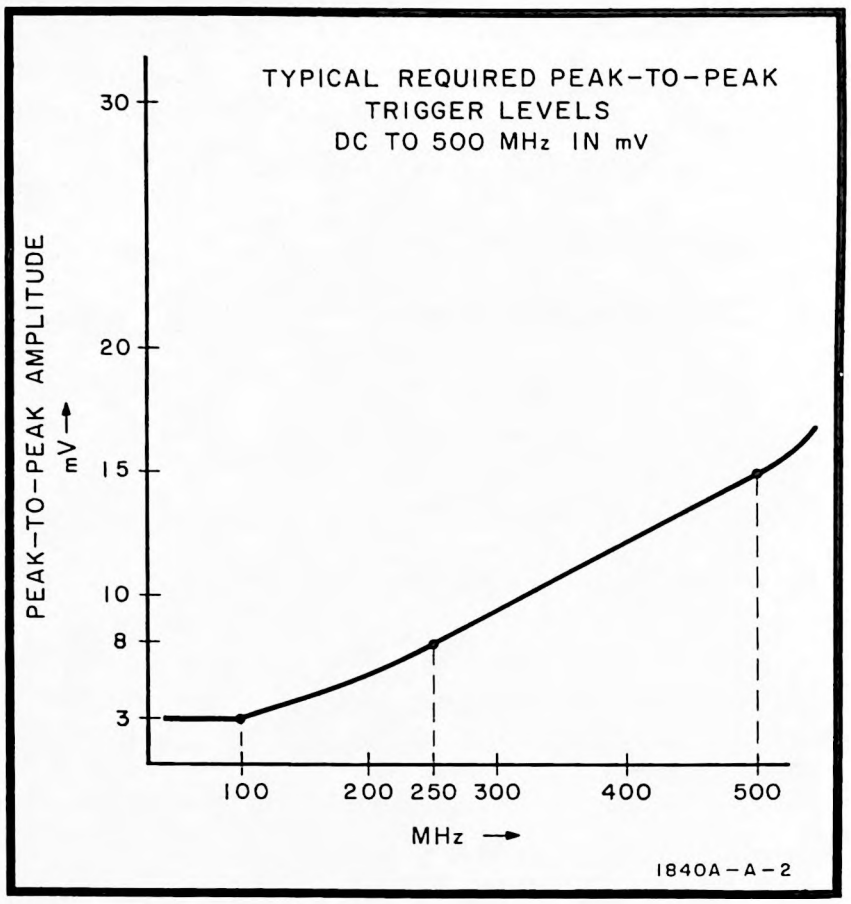


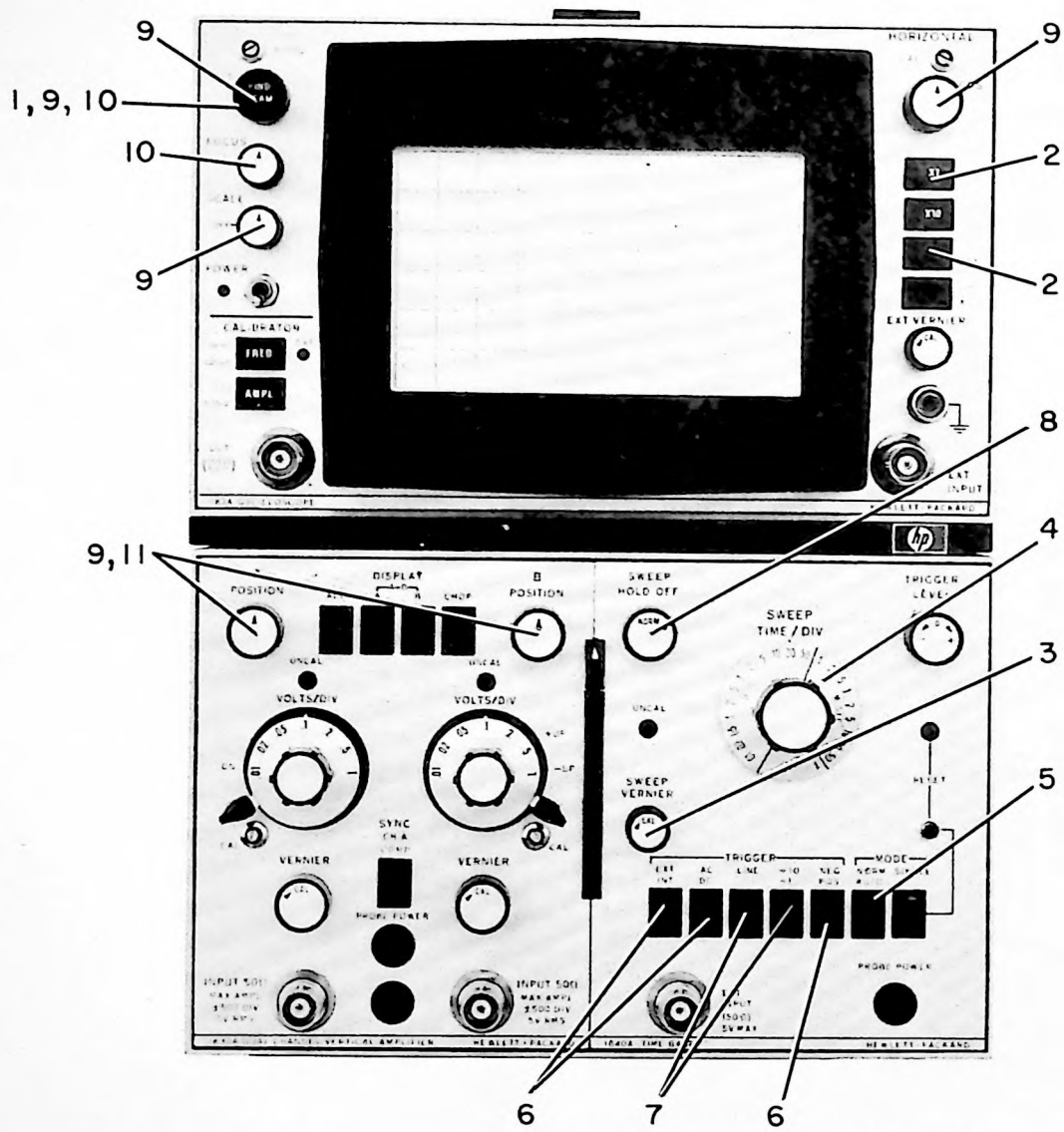

Figure 3-2. Typical Trigger Amplitude Requirements

period as set by the SWEEP TIME/DIV switch. This satifies the requirement that the trigger signal will pass through the lower and then upper threshold levels of the dual tunnel diode trigger circuit during the same arm period. If the trigger signal does not pass through the two threshold levels within the sweep time, the Time Base will automatically return to free-run operation.

3-22. During AUTO operation with a trigger signal applied, the time base will be triggered as in NORMAL operation. However there will be a momentary loss of display when the trigger signal is disconnected. The time for the display to reappear or for free-run operation to be restored is equal to the lock-out time or approximately 0.8 second. After sweep ends, the monostable multivibrator requires approximately 0.8 second to switch to its stable state. When the multivibrator switches states, the free-run operation is restored.

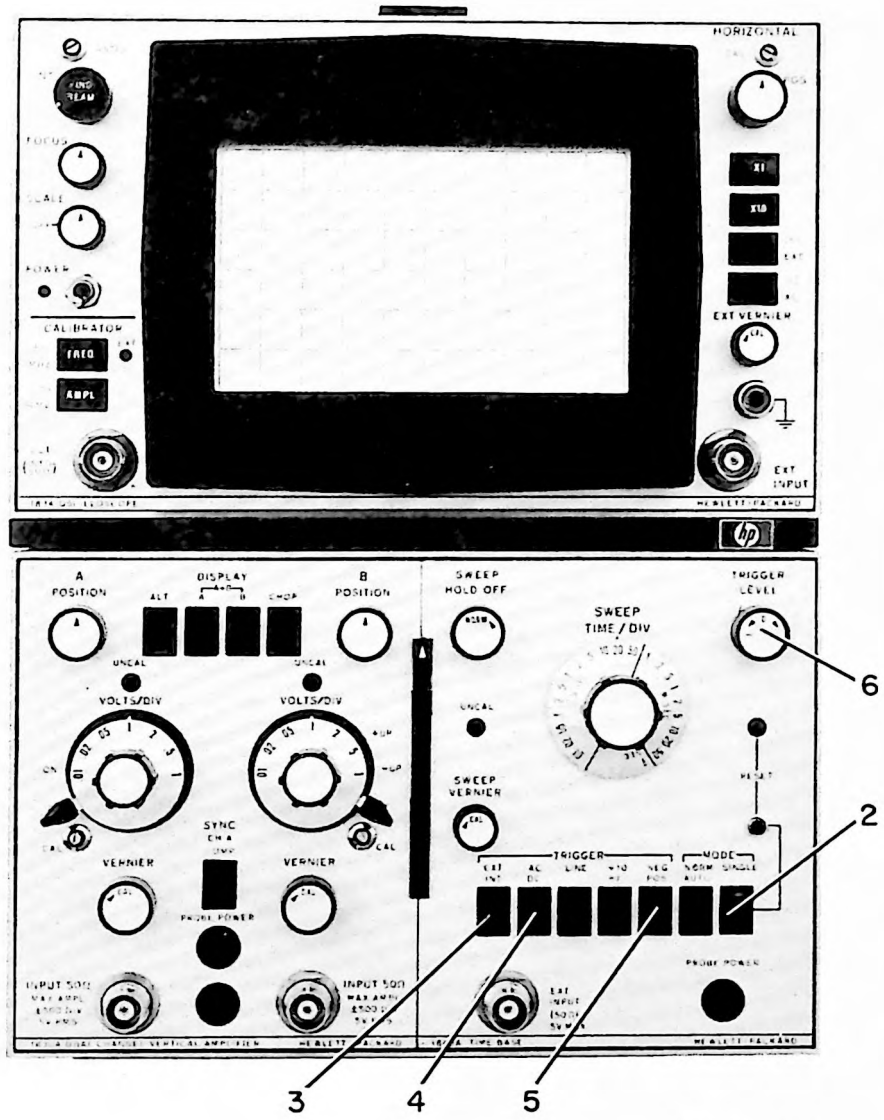
Table 3-1. Trigger Signal Requirements

| SWEEP MODE | TRIGGER SOURCE | TRIGGER COUPLING | MINIMUM TRIGGER AMPLITUDE | LEVEL | | SLOPE |
|---|---|---|---|---|---|---|
| NORM | LINE | | FIXED | | | S E L E C T A B L E + or − |
| | INT | | 0–250 MHz ⩾1.0 div of vertical deflection | In ÷1 | In ÷10 | |
| | | DC: dc to 250 MHz | 0–250 MHz ⩾20 mV pk-pk | Adjustable | Adjustable | |
| | EXT | AC: 5 kHz to 250 MHz | 250-500 MHz ⩾50 mV pk-pk<br>10 times greater for ÷10 | −100 mV to +100 mV | −1V to +1V | |
| AUTO | LINE | | FIXED | | | |
| | INT | | 5 kHz–250 MHz ⩾1.0 div of vertical deflection | In ÷1 | In ÷10 | |
| | | DC: 5 Hz to 250 MHz | 0–250 MHz ⩾20 mV pk-pk | Adjustable | Adjustable | |
| | EXT | AC: 5 kHz to 250 MHz | 250–500 MHz ⩾50 mV pk-pk<br>10 times greater for ÷10 | −100 mV to +100 mV | −1 to +1V | |
| SINGLE | Single may be selected after setting up any display. | | | | | − |




1. Set Intensity fully counterclockwise.
2. Set magnifier to X1 and horizontal display to internal.
3. Set SWEEP VERNIER fully clockwise to CAL.
4. Set SWEEP TIME/DIV to 1 MSEC.
5. Set Sweep MODE to AUTO.
6. Set TRIGGER source to INT, TRIGGER coupling to DC and TRIGGER slope to + (positive).
7. Set TRIGGER amplitude division switch to ÷1 and turn off LINE signal (blue ring visible).
8. Set SWEEP HOLD-OFF fully counterclockwise to NORM.
9. Press beam finder and adjust intensity and position controls, if necessary, to locate trace.
10. Adjust intensity and focus for bright and focused trace.
11. Adjust position controls to center trace at mid-screen.

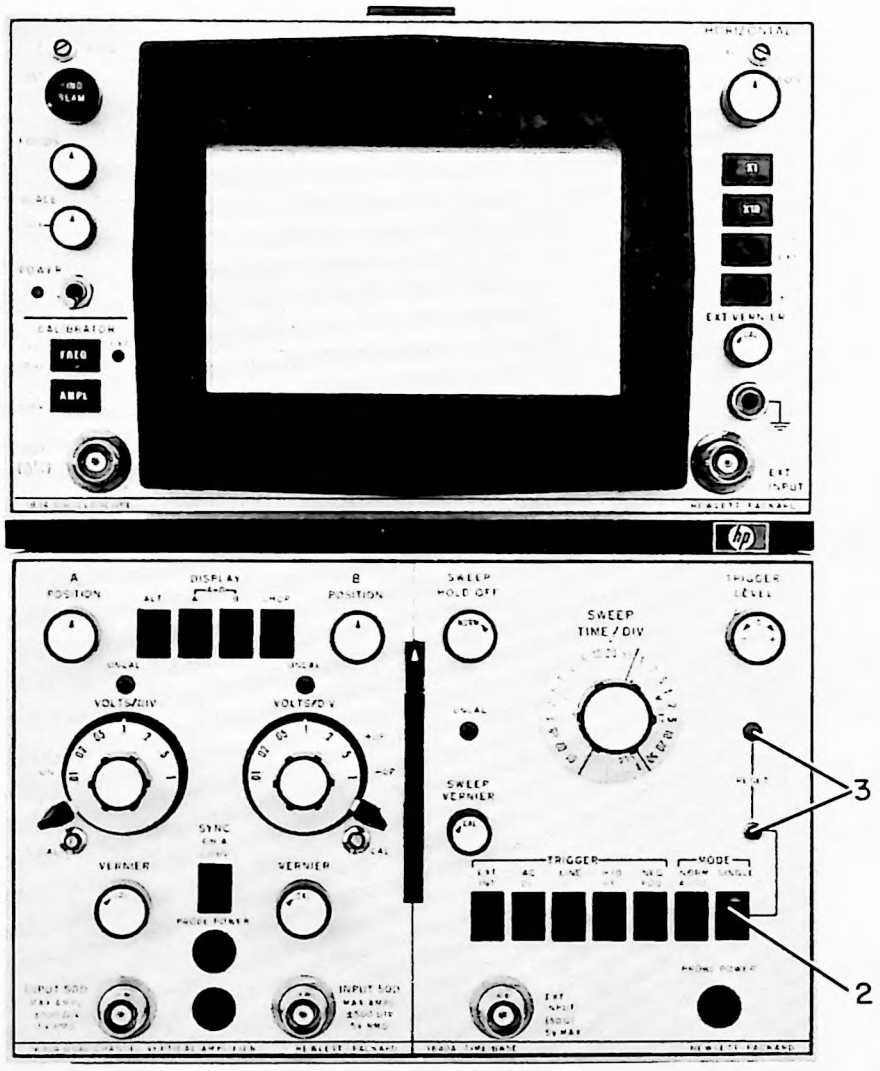
Figure 3-3. Initial Turn-on Procedure (AUTO MODE)




1840A-A-4

1. Perform initial turn-on procedure of Figure 3-3.
2. Set Sweep MODE to NORM.
3. Select TRIGGER source as desired (if EXT is selected connect trigger signal to EXT INPUT).
4. Select desired TRIGGER Coupling.
5. Select desired TRIGGER Slope.
6. Adjust TRIGGER LEVEL for desired trigger point.

Figure 3-4. NORM Sweep Operation




1840A-A-5

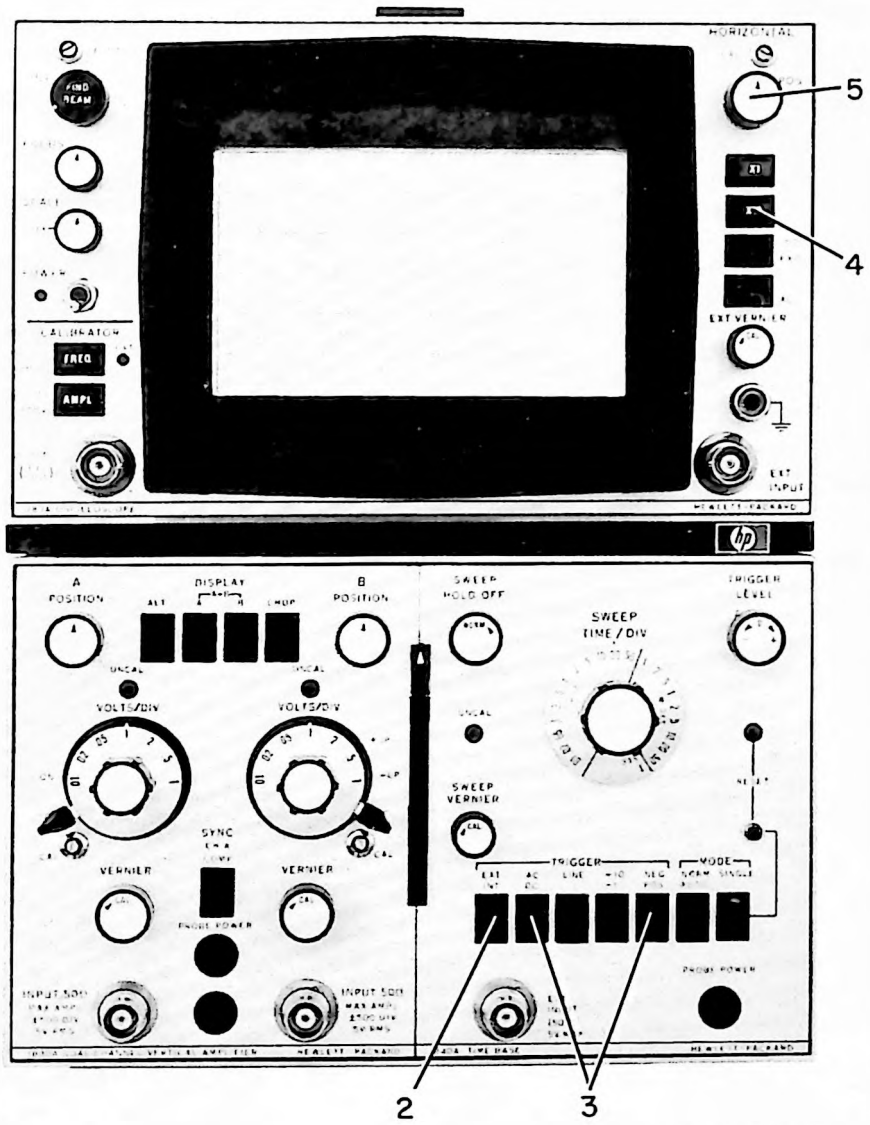
1. Perform NORM sweep operation procedure of Figure 3-4.

2. Set Sweep Mode to SINGLE.

3. Press RESET pushbutton. The RESET indicator should light, showing that sweep is armed.

4. The first trigger input will start sweep. After one sweep, RESET indicator will go out. The sweep must be rearmed by pressing RESET pushbutton or supplying a new external RESET trigger to rear panel jack of Model 183A for another display.

Figure 3-5. SINGLE Sweep Operation




1. Perform initial turn-on procedure of Figure 3-3.
2. Set TRIGGER source as desired (if EXT is selected, connect trigger signal to EXT INPUT).
3. Select the desired Coupling and Slope.
4. Set magnifier to X10.
5. Adjust horizontal position to view any part of display.
6. Divide SWEEP TIME/DIV setting by 10 to obtain actual time/div.

Figure 3-6. Sweep Magnification Operation

# SECTION IV

# PRINCIPLES OF OPERATION

## 4-1. INTRODUCTION.

4-2. Descriptions of basic circuits used in Model 1840A are covered at the beginning of this section. A block diagram, Figure 4-7, with a brief overall functional explanation is given following the basic circuit paragraphs. The last paragraphs give detailed circuit descriptions (keyed to the schematics) of the Model 1840A.

## 4-3. BASIC CIRCUIT DESCRIPTIONS.

### 4-4. COMPARATOR.

4-5. Comparators are used in this instrument to reference a signal to a dc level. A basic comparator is shown in Figure 4-1. Bias for both transistors is adjusted by R4. If the arm of R4 is moved toward the positive supply voltage, current increases through Q2 and decreases through Q1. Moved in a negative direction, R4 reverse biases Q2 and forward biases Q1. Since R4 controls the quiescent dc voltage levels of this circuit, it is called a LEVEL control.

4-6. When the positive excursion of an input signal applied to the base of Q1 reaches an amplitude sufficient to overcome the bias set by R4, Q1 increases conduction. A voltage is dropped across R1, and output A moves in a negative direction. At the same time, a voltage is dropped across R3, making the emitter of Q2 more positive. Therefore, Q2 conduction decreases, and output B moves in a positive direction. During the negative excursion of an input signal, conditions reverse. Conduction decreases for Q1 and output A moves positive; conduction increases for Q2 and output B moves negative. Thus, as input signal polarity alternates, so does the amount of conduction for the two transistors.

4-7. The Model 1840A has two comparator circuits. First is the trigger comparator which produces two differential output signals for further amplification. Second, a comparator is used in the sweep reader circuit where one output is required. The output is the dc voltage level at the collector of A1Q14B which restores a dc level to the sweep signal.

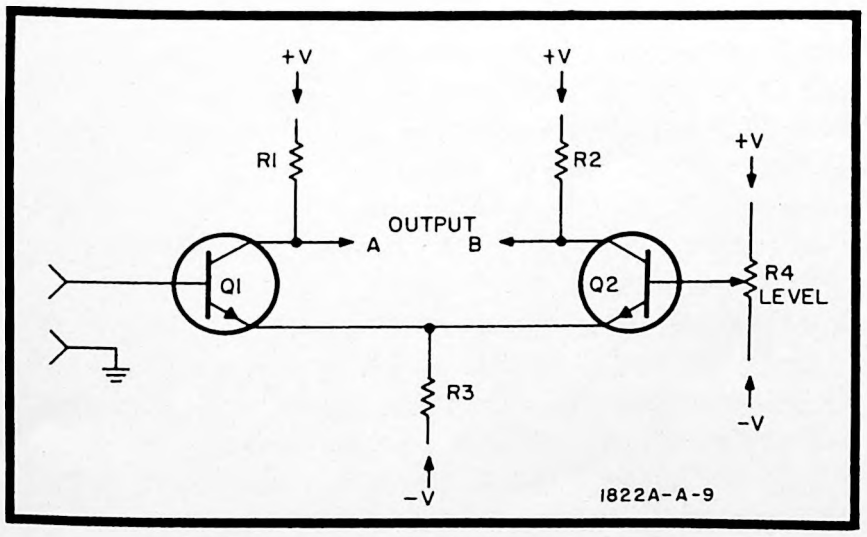



Figure 4-1. Basic Comparator

### 4-8. DIFFERENTIAL AMPLIFIER.

4-9. Figure 4-2 shows a basic differential amplifier. Only out-of-phase (difference) signals are amplified by this circuit. In-phase waveforms applied to both inputs are called common-mode signals. These, often in the form of unwanted noise and stray pick-up, are rejected.

4-10. Input signals of opposite polarity cause one transistor to increase conduction and the other to decrease conduction. Since the output is taken across the two collectors, input signals are amplified and voltage drops across R2 and R3 are summed.

4-11. When common-mode signals are applied, both transistors either increase or decrease conduction and cause equal current changes through R2 and R3. Thus, no output is developed with common-mode signals.

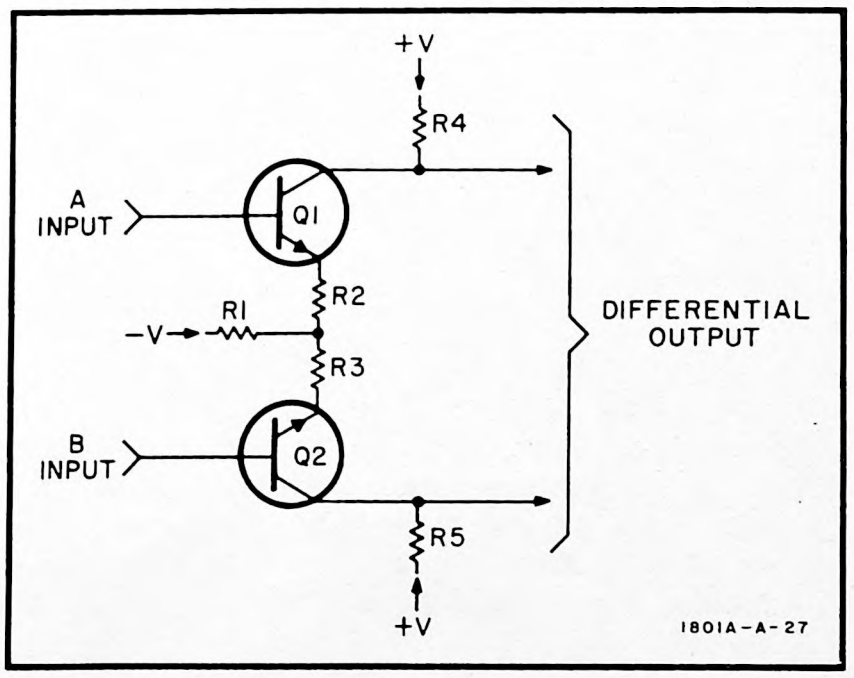



Figure 4-2. Basic Differential Amplifier

### 4-12. SCHMITT TRIGGER.

4-13. A Schmitt trigger circuit (Figure 4-3) is a type of triggered multivibrator. This circuit is characterized by two stable states and a fast risetime and falltime. Initially Q1 is cutoff and Q2 is in saturation. Current through Q2 develops a voltage drop across R4, reverse biasing Q1 and ensuring no Q1 conduction. If a positive trigger is applied

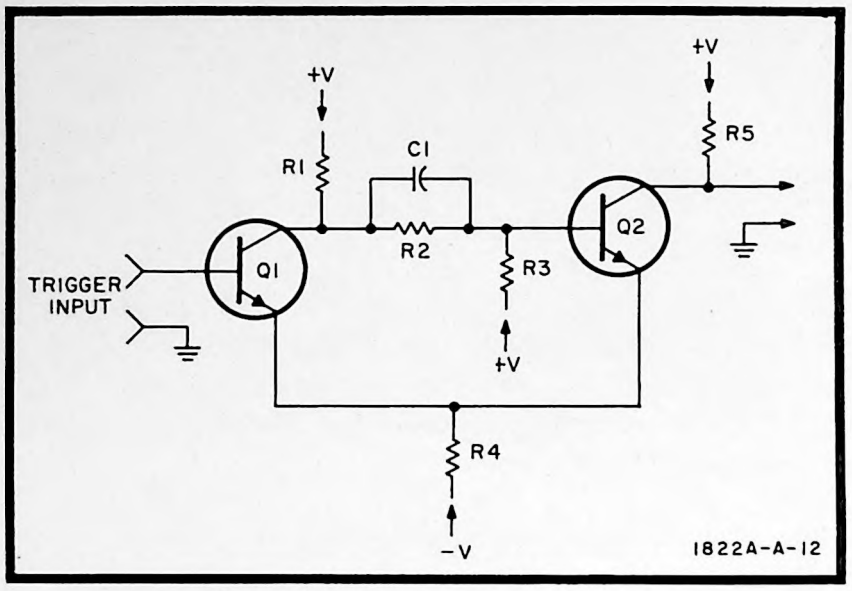



Figure 4-3. Basic Schmitt Trigger

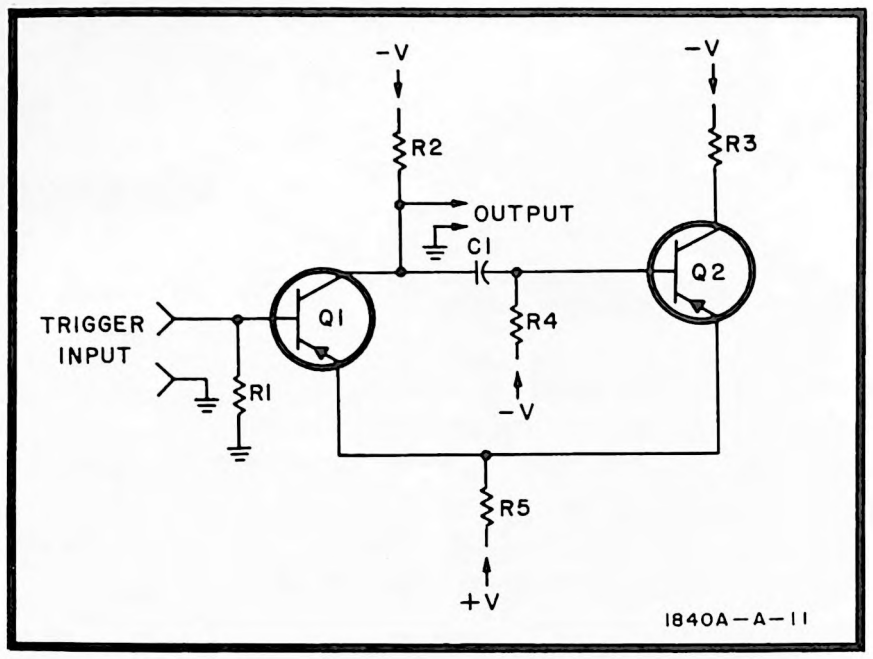



Figure 4-4. Basic Monostable Multivibrator

to the base of Q1, forward bias is aided and Q1 starts to conduct. As current flows through R1, a voltage is dropped across it, and the collector of Q1 goes negative. This negative voltage is coupled through R2 to the base of Q2. Conduction for Q2 decreases, removing the voltage drop across R4 and removing the reverse bias from Q1. Now Q1 saturates and Q2 goes into cutoff. The circuit remains in this state until the input trigger to Q1 goes sufficiently negative to remove the forward bias from Q1.

### 4-14. MONOSTABLE MULTIVIBRATOR.

4-15. A simple emitter-coupled monostable multivibrator is shown in Figure 4-4. This circuit has only one stable state, that is, one transitor is normally saturated and the other is cut off. Operation reverses temporarily when an input signal is applied, then the circuit reverts back to the stable state by itself. The time necessary for the monostable multivibrator to revert back to the stable state is established by the timing capacitor (C1) and timing resistor (R4). This cycle repeats for each trigger pulse applied. Another name for this circuit is one-shot multivibrator.

4-16. During quiescence, Q2 is saturated and Q1 is cut off due to supply voltages. This is the stable state. A negative-going trigger applied to the base of Q1 forward biases the transistor and starts conduction. A voltage is dropped across R2, and the collector of Q1 goes positive. At this point C1 discharges through R4, driving the base of Q2 positive and reverse biasing it. Now Q1 saturates and Q2 cuts off. After C1 discharges through R4, Q2 is again forward biased by the supply voltage and starts conducting. As Q2 draws current through R5, a negative-going voltage at the top of R5 reverse biases the emitter of Q1 with respect to base and Q1 cuts off. The circuit has now returned to the stable state and will remain in this condition until another trigger signal is applied.

4-17. The HP Model 1840A uses a pulse to control the monostable multivibrator. The period of the pulse is equal to the sweep gate period. The sweep gate signal will keep the multivibrator in the unstable state. After the gate ends, the multivibrator will continue in the unstable state for a period determined by the timing capacitor (C1) and timing resistor (R4).

## 4-18. OVERALL CIRCUIT DESCRIPTION.

4-19. The HP Model 1840A Time Base consists of trigger, gate, and sweep circuits. Refer to the block diagram, Figure 4-7, for the following description. The time base can be triggered or set to free run. When triggered operation is used, the required trigger signal is coupled to the trigger comparator and amplifiers through the trigger selection and conditioner circuits. The trigger signal is coupled from one of three inputs: external (EXT) input, internal (INT) input, or line frequency (LINE) from power transformer. Free-run operation is selected by setting the MODE switch to AUTO. In this position, the Model 1840A operates without a trigger signal. However, if a trigger signal is applied, it will override the free-run operation and generate the sweep. The trigger-coupling switch determines the type of coupling for the incoming trigger signal while the TRIGGER LEVEL control selects the voltage point on the selected slope where sweep generation starts. Selection of positive or negative slope of trigger signal for sweep generation is accomplished in the polarity selection circuit.

4-20. In NORM operation, the dual tunnel diode trigger circuit produces a negative rectangular pulse which is applied to the oscilloscope CRT through the gate output circuit for unblanking the trace. Also, the negative pulse is applied to the sweep integrator circuit. The sweep integrator circuit is normally clamped so that the output is a constant dc voltage. The negative gate signal unclamps the sweep integrator circuit which generates a positive-going sawtooth signal. This sweep signal is coupled through the sweep reader circuit to the oscilloscope for horizontal deflection. The sweep signal is also applied to length Schmitt and hold-off circuits through the hold-off driver. At approximately 10 volts, the length Schmitt circuit switches to the other state, turning the dual tunnel diode trigger circuit off to end the sweep ramp in

the sweep integrator. After the sweep ramp ends, the sweep integrator will return to the quiescent level. At the same time, the hold-off capacitor will begin to discharge to 0 volt. At approximately 1 volt, the length Schmitt circuit will switch back to the pre-trigger state. The length Schmitt resets the control reset and the dual tunnel diode trigger circuit for the next trigger pulse. The dual tunnel diode trigger circuit will again start the sweep gate signal and repeat the sweep cycle.

4-21. When operating in AUTO MODE, the input from the control reset to the dual input gate circuit is baised so that when the control reset is rearmed, the dual input gate circuit generates a new gate and sweep. At the end of the hold-off time, the control reset changes states. The control reset will be rearmed and a new gate will be generated, resulting in a new sweep. The sweep period is determined by the SWEEP TIME/DIV switch which also determines the frequency of free-run operation. If, however, a signal of 5 hertz or greater is applied to the dual tunnel diode trigger circuit, it will override the AUTO circuit and lockout free run operation.

4-22. When the MODE switch is set to SINGLE, the sweep reset circuit overrides the hold-off circuit in the length Schmitt circuit and controls the reset operation. The gate generator can then be reset by manually switching the length Schmitt to the pre-trigger state or by an EXT input from the rear panel of the Model 183A/B Oscilloscope.

## 4-23. CIRCUIT DETAILS.

4-24. The following paragraphs explain the theory of operation of the Model 1840A. See the block diagram, Figure 4-7, and the schematics in Section VIII while reading the text. An explanation of the reference designator system used in this manual is located in Section VIII.

## 4-25. NORMAL SWEEP OPERATION.

### 4-26. TRIGGER INPUT CIRCUIT.

4-27. Three trigger sources can be selected by the front-panel switches EXT/INT, A1A1S1, and LINE, A1A1S3. The internal trigger signal can be received from connector P2 or P3. When the Model 1840A is used with the vertical amplifier of the HP 183-series oscilloscopes, the internal signal is applied through P3 and supplied directly to A1A1S1. The Model 1840A can also be used with vertical amplifiers in the HP 180-series oscilloscopes and the trigger signal is supplied through P2. The trigger signals from HP 180-series vertical amplifiers are ac-terminated into 100 ohms, and are terminated by A1R2 at all times into the 50-ohm system of the Model 1840A. The position of A1A1S1 determines the trigger signal to be used and the other trigger signal is terminated into 50 ohms. The termination prevents coupling of unwanted signals into the time base.

4-28. AC/DC Switch A1A1S2 selects the coupling desired. DC couples the selected trigger directly to the LINE switch. AC removes the dc portion of the trigger signal and attenuates frequencies below approximately 5 kilohertz. The trigger signal is then supplied to LINE TRIGGER switch A1A1S3. If LINE is selected, the previously selected trigger signal is terminated into 50 ohms by resistor, A1R6. The LINE trigger is a 3-volt ac peak-to-peak signal obtained from the power transformer. After the coupling switch (AC/DC), the selected trigger signal is supplied to the ÷1/÷10 switch, A1A1S4. In ÷1, the trigger signal is supplied directly to the trigger comparator and is terminated by the 50-ohm input of the trigger comparator. If ÷10 is selected, the trigger signal is attenuated by a factor of 10 and is also terminated by the 50-ohm input of the trigger comparator.

### 4-29. TRIGGER AMPLIFIER.

4-30. The trigger signal is applied to the trigger amplifier where the trigger level point and polarity are selected. Diodes A1CR2 and A1CR3 are overload protection diodes for the base-emitter junctions of transistors A1U1Q1 and Q2. TRIGGER LEVEL control R1 sets the trigger point where gate generation starts. The trigger level is applied to the trigger comparator circuit at A1U1Q2. Transistor A1U1Q2 has an input impedance of 50 ohms which is established by resistor A1R15. The trigger level range of the Model 1840A is ±100 millivolts for the ÷1 input and ±1 volt for the ÷10 input. The trigger signal is converted to a differential voltage signal by A1U1Q1 and Q2. Resistor A1R19 is the trigger amplifier balance which is used to balance any dc offset in A1U1Q1 and Q2. Also, the trigger amplifier balance adjustment sets the TRIGGER LEVEL potentiometer zero to center of range.

4-31. The trigger signal is amplified and converted to a current signal by the first stage of the trigger amplifier for the polarity function. Diodes A1CR4-7, in association with polarity switch A1S5, make up the polarity-selection circuit. When + (positive) slope is selected, a positive voltage is applied to the anode of A1CR6 and a negative voltage is applied to the cathode of A1CR7. The trigger signal is coupled from A1U1Q3 to A1U2Q1 and from A1U1Q4 to A1U2Q2. If – (negative) slope is selected, a positive voltage is applied to A1CR5 and a negative voltage is applied to A1CR4. The trigger signal is coupled from A1U1Q3 to A1U2Q1 and from A1U1Q4 to A1U2Q3. The signal current through A1R28 develops a signal voltage across A1R28. The trigger signal is voltage amplified by A1U2Q1 and Q2. The trigger signal is coupled to A1U2Q3 and A1U2Q4, part of the dual tunnel diode trigger circuit.

### 4-32. DUAL TUNNEL DIODE TRIGGER CIRCUIT.

4-33. Transistors A1U2Q3 and U2Q4 along with diodes A1CR8 and CR9, form the dual tunnel diode trigger circuit. Tunnel diode A1CR8 receives current from the negative supply through transistor A1U2Q3 and resistor R34. Tunnel diode A1CR9 receives current from the same

negative supply through transistor A1U2Q4 and resistor A1R34. Initially current is supplied to A1CR9 from the collector of Q3 in the control reset circuit. However, the current is insufficient to switch A1CR9 to the high voltage state. The current supplied to A1CR8 by A1R43 and R44 is insufficient to switch tunnel diode CR8 to the high-voltage state.

4-34. The sync signal is applied differentially to the dual tunnel diode trigger circuit. During the positive portion of the trigger signal applied to the base of A1U2Q4, there will be a signal level that will supply enough additional current to A1CR9 to switch A1CR9 to the high-voltage state. When the next positive portion of the input signal arrives at the base of A1U2Q3, sufficient current will flow through A1CR8 to switch A1CR8 to the high-voltage state. With A1CR8 and A1CR9 conducting, the bias established across A1R35 is that bias required to keep A1CR8 and CR9 in the high-voltage states. When A1CR8 is in the high-voltage state, a negative gate pulse is generated and lasts as long as A1CR8 is in that state.

4-35. When hold-off time starts, A1Q4 is driven into conduction and current flow through A1Q3 is cut off. The reduction in current through A1Q3 causes A1CR8 and CR9 to switch to the low-voltage states. After hold-off time ends, the current flow through A1Q3 is restored but is not adequate to turn on A1CR9.

4-36. In order for the dual tunnel diode trigger circuit to respond to the next trigger pulse, A1CR9 must be switched to the high-voltage state before A1CR8. When the positive portion of the sync signal arrives at the base of A1U2Q4, the current through A1U2Q4 will increase and supply the additional current required to switch A1CR9 to the high-voltage state. The point where A1CR9 turns on is the lower hysteresis limit. When the dual tunnel diode trigger circuit passes through the lower hysteresis limit, the circuit is rearmed and ready to produce a new gate. The next positive portion of the trigger signal at the base of A1U2Q3 will switch A1CR8 to the high-voltage state and start a new gate. The voltage level required is the upper hysteresis limit. Thus the dual tunnel diode trigger circuit must pass through the lower then upper hysteresis limits before a new gate is generated.

**4-37. GATE CIRCUIT.**

4-38. The negative gate from A1CR8 is applied to the dual input gate circuit at the base of transistor A1U1Q1, resulting in a differential gate output from the collectors of A1U4Q1 and Q2. Throughout normal operation, transistor A1U4Q3 is biased off. The differential gate signal is coupled to another differential amplifier (transistors A1Q5 and Q6) which increases the amplitude of the gate signal to ensure rapid signal currents at A1Q7 and Q9. The differential gate signal from the collectors of A1U4Q1 and Q2 is at an average level of +15 volts. The average level of +15 volts must be shifted to an average level of about −9 volts before the gate signal can be applied to the bases of A1Q7 and Q9. Zener diodes A1VR2 and VR3 accomplish the shift to approximately −9 volts as well as limit power dissipation in A1Q5 and Q6.

4-39. The negative-going gate pulse at the base of transistor A1Q7 produces two outputs. First, the alternate trigger output is supplied to J1, pin 22 from the collector of transistor A1Q7. The alternate trigger signal is opposite the polarity of the base of transistor A1Q7. Second, the gate output is supplied to P1, pin 17 from the collector of transistor A1Q8. The gate output signal is the same polarity as the base of transistor A1Q7. The alternate trigger signal is supplied to the vertical amplifier for ALT operation of the vertical amplifier. For 180-series vertical amplifiers, the alternate trigger signal is supplied by the HP Model 183A/B Oscilloscope and is coupled from P1, pin 6 to J1, pin 24. The alternate trigger signal for a 183-series vertical amplifier is coupled directly to the vertical amplifier to avoid time delay of the alternate trigger signal. The time delay would limit the alternate switching rate.

4-40. The positive-going gate pulse at the base of A1Q9 also produces two functions. First, a gate output of opposite polarity is supplied to the rear panel of the Model 183A/B Oscilloscope. The gate signal is coupled through P1, pin 13. Second, the gate signal determines the time allowed for selected integrator capacitor to develop a positive charge.

4-41. Prior to the gate signal at the base of transistor A1Q9, the sweep current for transistor A1Q33 was supplied by transistor A1Q10. When the gate signal arrives, transistors A1Q10 and Q11 are turned off. The sweep current through diode A1CR17 is then supplied by the selected sweep timing capacitor. During the ramp sequence, transistor A1Q20 is biased off.

4-42. The current source for the sweep timing capacitor must have high output impedance. The collector circuit of transistor A1Q33 provides the required impedance. Because of the common-base configuration of transistor A1Q33 and because the base current is held constant, the current flow to the sweep timing capacitor will be constant. Voltage drop across the selected sweep timing resistor determines the current into the emitter of transistor A1Q33. The voltage drop is constant and is established by the potential difference between the emitter of transistor A1Q33 and the base of transistor A1Q35. By changing the sweep timing resistor, the current flow to the sweep timing capacitor will also change. The potential at the base of transistor A1Q35 is equal to the potential at the base of transistor A1Q36 and is set by R3. Transistor A1Q35, connected as a diode, provides an offset compensation so that the voltage at the base of transistor A1Q35 is at approximately the same voltage as the base of transistor A1Q36.

4-43. When the SWEEP VERNIER is switched out of the detent position and is rotated in a counterclockwise

direction, the level at the bases of transistors A1Q36 and Q35 decreases. This decreases the current flow through transistors A1Q36 and Q34. The sweep timing capacitor requires more time to reach approximately +10 volts and the longer charge time results in slower sweep speeds. Also the UNCAL indicator lights when this operation is used to indicate when the time base is not in calibrated operation.

## 4-44. SWEEP READER CIRCUIT.

4-45. The ramp voltage developed on the sweep timing capacitor is applied to the gate of field-effect transistor (FET) A1Q13 of the sweep reader circuit. Transistors A1Q12, Q13, Q14, Q16, and Q17 make up the sweep reader circuit. The high input impedance of transistor A1Q16 allows the drain of transistor A1Q13 to follow the gate within 1%. Transistor A1Q13 has unity gain because of the source-follower configuration. The ramp signal is capacitively coupled to transistor A1Q16 to remove the dc component of the signal. The ramp signal again passes through a unity-gain amplifier consisting of A1Q16 and Q17 with a resulting sweep ramp from 0 to +10 volts.

4-46. The dc level of the sweep is established by comparator transistors A1Q14A and Q14B and is coupled back to the sweep ramp signal at the base of transistor A1Q16. The sweep ramp at the base of A1Q13 couples through the high frequency roll-off circuit (resistor A1R92 and capacitor A1C15) to the base of transistor A1Q14A in the comparator. The output sweep ramp at the emitter of A1Q17 is also coupled through a high frequency roll-off circuit (resistor A1R97 and capacitor A1C17) to the base of A1Q14B. The resultant level of the comparator at the collector of A1Q14B is restored to a sweep ramp signal at the base of transistor A1Q16. This function ensures a constant dc level of the sweep ramp. The sweep signal from the emitter of A1Q17 is then supplied to the horizontal amplifier in the Model 183A/B oscilloscope through P1, pin 1. The input impedance at the horizontal amplifier, with resistor A1R99, converts the sweep ramp from a 0-to-+10-volt signal to a 0-to-2.5-milliampere signal.

## 4-47. SWEEP TERMINATION.

4-48. The hold-off driver circuit, transistors A1Q18 and Q19, is an emitter follower of low dc offset with thermal compensation whose purpose is to isolate the length Schmitt circuit and the hold-off circuit from the sweep reader circuit. As the sweep ramp develops on the emitter of transistor A1Q19, diode A1CR36 turns on at approximately 8 volts. The base of transistor A1Q32 is drawn positive, causing the length Schmitt to change states at approximately 10 volts. When the length Schmitt changes state, a positive pulse is developed at the collector of transistor A1Q31 which is coupled to control reset transistors A1Q3 and Q4. The control reset changes state, turning off transistor A1Q3 and removing the current supply to tunnel diodes A1CR8 and CR9. Both A1CR8 and CR9 turn off and end the gate. Turning off the sweep gate results in a positive transition that turns on transistors A1Q10 and Q11. The current for transistor A1Q33 is again supplied by A1Q10. Transistor A1Q11 supplies a discharge path for the sweep timing capacitor. During the positive transition at the collector of transistor A1Q31, current is supplied through resistor A1R108 to the base of transistor A1Q20. Transistor A1Q20 is turned on and aids in rapidly discharging the sweep timing capacitors.

## 4-49. HOLD-OFF CIRCUIT.

4-50. As the sweep voltage increases, diode A1CR24 turns on and the hold-off capacitor charges positively. When the sweep resets, diode A1CR24 becomes reverse-biased and the hold-off capacitors discharge because of the current supplied by the collector of transistor A1Q27. The hold-off signal is applied to the hold-off reader circuit, transistors A1Q21 and Q22, a thermal-compensated emitter-follower pair. The hold-off circuit discharges from +10 volts to 0 volt. At approximately 5 volts, the voltage divider resistors A1R110 and R109 apply about 0 volt to the anode of diode A1CR23. This hold-off voltage level turns off diode A1CR23. The current supplied by A1R107 now flows through diode A1CR22 which establishes a bias on transistor A1Q20, fast reset circuit. The bias will turn off transistor A1Q20 approximately half way through the hold-off period. Transistor A1Q20 must be turned off half way through the hold-off period to ensure that all base charge is removed from A1Q20 when the new sweep starts.

4-51. During the sweep period, the collector of A1Q31 is at its low level. The current that flows through transistor A1Q31 also flows through resistor A1R108. The current develops a voltage level at the cathode of diode A1CR21 that will forward bias diode A1CR21. Capacitor A1C19 capacitor will charge to approximately −0.6 volt. At the end of a sweep, the collector of transistor A1Q31 will switch to the high-voltage level and will permit transistor A1Q20 to conduct. Transistor A1Q20 will permit rapid discharge of the sweep timing capacitor. However, the discharge operation is delayed by the time required for capacitor A1C19 to discharge and permit transistor A1Q20 to conduct. This ensures that the discharge current through transistor A1Q20 does not start before the gate turns off in the integrator circuit.

4-52. The hold-off ramp on the emitter of transistor A1Q21 continues to decrease. When the emitter of transistor A1Q21 reaches approximately 1.0 volt, enough current is generated in resistor A1R111 to supply current to resistors A1R112 and A1R141. The current flow will cause the base voltage of transistor A1Q32 to decrease enough to switch the length Schmitt to the stable state. The change in level on the collector of transistor A1Q31 causes the control reset to change states and transistor A1Q3 again supplies arming current to tunnel diode A1CR9.

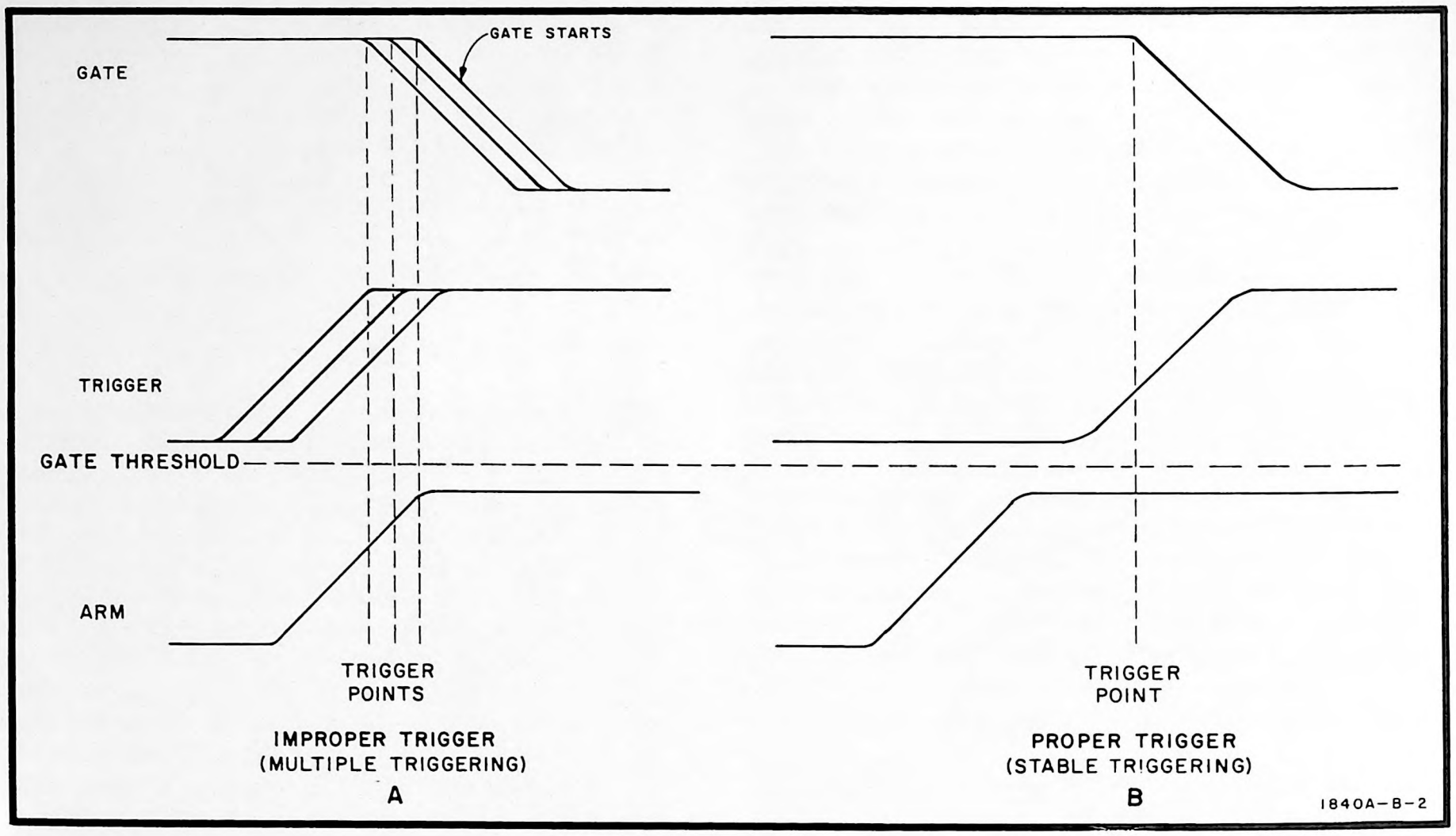



Figure 4-5. Sweep Trigger Level Analysis

**4-53. AUTOMATIC HIGH-FREQUENCY STABILITY CIRCUIT.**

4-54. It is possible for the arming pulse to occur at about the same time as the trigger pulse and cause unstable triggering on the screen of the CRT. To avoid the various combinations of triggering time illustrated in Figure 4-5A, the hold-off time is shortened to ensure that the arming current is present and stabilized before the trigger pulse arrives in the dual tunnel diode trigger circuit.

4-55. The sweep stability is established in the automatic high frequency stability circuit of transistors A1Q23-Q25. The negative-going sweep gate is applied to the base of transistor A1Q23. The current signal that is developed on the emitter of transistor A1Q23 is combined with the inverse arming current signal in "and" gate A1R120, CR27, and CR28 and the resultant signal (combined signal of the gate signal and inverse arming signal) is applied to the base of transistor A1Q25. The current signal is inverted by A1Q25 and the resultant signal is a negative-going voltage pulse.

4-56. The voltage signal that is developed on the emitter of transistor A1Q23 is differentiated by resistor A1R118 and capacitor A1C20. The resultant negative voltage is inverted by transistor A1Q24. The two signals from transistors A1Q24 and A1Q25 produce a positive voltage charge on capacitor A1C21. The two signals are of opposite polarity and the resultant voltage is analogous to the difference. The analog voltage is applied to source follower transistor A1Q26. The signal at the source of transistor A1Q26 is dc coupled to transitor A1Q27, hold-off current source, and causes a change in hold-off time.

4-57. For normal operation, the differentiated gate signal and the combined gate and inverse arming signals are equal in width and amplitude. This results in constant hold-off current through transistor A1Q27. If the arming signal occurs closer in time to the trigger signal, the combined gate and inverse arming pulse becomes narrower. This causes a more positive voltage charge on capacitor A1C21 which increases the hold-off discharge rate and decreases the hold-off time. Decreasing the hold-off time assures that the arming current is present and stable before a new trigger pulse arrives.

4-58. Figure 4-5 illustrates the necessity for the automatic high frequency stability circuit. Part A shows three conditions that can occur and Part B shows an ideal situation. When the sum of the levels of the trigger and arming signals reaches gate threshold in the dual tunnel diode trigger circuit, a new gate will be produced. If the trigger signal varies in time in relation to the arming signal, different sums of levels will reach gate threshold and start a new gate. However, if the leading edge of the arming signal is advanced in time or hold-off time shortened, as in Part B of Figure 4-5, the arming signal will be at maximum level and be stabilized before the trigger signal arrives. The additional level required to produce a new gate will be the same from trigger signal to trigger signal.

## 4-59. AUTO OPERATION.

4-60. When AUTO MODE is selected (with SINGLE MODE pushbutton out), approximately 200 microamperes are applied to the collector of transistor A1U3Q3 and base of transistor A1Q1. Transistor A1Q1 will turn on and cause transistor A1U3Q5 to turn off, establishing a bias on the base of transistor A1U4Q3. With the bias, a small shift in signal at the collector of transistor A1Q4 will turn on transistor A1U4Q3. Transistor A1U4Q3 will produce a gate signal at the end of the hold-off time. The negative transition on the base of transistor A1Q4 of the control reset circuit changes the state of the control reset, turning off transistor A1Q4. With transistor A1Q4 off, a positive transition at the collector will also turn on transistor A1U4Q3 and generate a gate to permit a sweep ramp to be generated.

4-61. When a trigger signal is supplied to tunnel diode A1CR8, the gate signal is generated and applied to the base of transistors A1U3Q1 and A1U4Q1. The resultant gate signal on the collector of transistor A1U3Q1 is a positive transition applied to the monostable multivibrator. The multivibrator will switch states and apply a negative transition to the base of transistor A1Q1 which will turn off transistor A1Q1 and turn on transistor A1U3Q5. The negative transition on the collector of transistor A1U3Q5 will cause transistor A1U4Q3 to go further into cutoff. No transition on the collector of transistor A1Q4 will produce a new gate in the dual input gate circuit. Hence, the free-run operation is locked out.

4-62. To override free-run operation, the trigger signal must make a 20-millivolt excursion in EXT or 1-division excursion in INT during the sweep period as set by the SWEEP TIME/DIV switch. This satisfies the requirement that the trigger signal will pass through the lower and upper threshold levels of the dual tunnel diode trigger circuit during the same arming period. If the trigger signal does not pass through the two threshold levels within the sweep time necessary, the time base will automatically return to free-run operation.

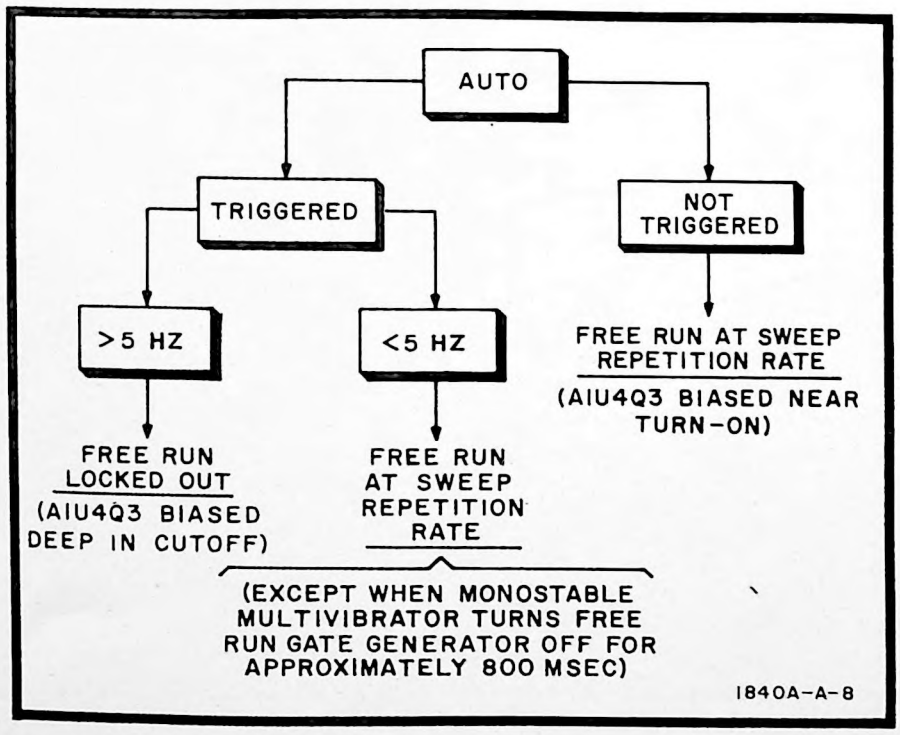

AUTO
TRIGGERED
NOT TRIGGERED
>5 HZ
<5 HZ
FREE RUN AT SWEEP REPETITION RATE
(AIU4Q3 BIASED NEAR TURN-ON)
FREE RUN LOCKED OUT
(AIU4Q3 BIASED DEEP IN CUTOFF)
FREE RUN AT SWEEP REPETITION RATE
(EXCEPT WHEN MONOSTABLE MULTIVIBRATOR TURNS FREE RUN GATE GENERATOR OFF FOR APPROXIMATELY 800 MSEC)
1840A-A-8

Figure 4-6. AUTO Operation

4-63. If the trigger signal period is less than 0.2 second or a frequency greater than 5 hertz, the monostable multivibrator cannot switch states. The free-run lock out circuit will continue to lock out free-run operation. If the trigger signal period is greater than 0.2 second or a frequency less than 5 hertz, the monostable multivibrator will switch states. This will establish a voltage level on the collector of transistor A1U3Q5 so that transistor A1U4Q3 will turn on when hold off ends, restoring free-run operation.

4-64. Figure 4-6 illustrates AUTO operation. If the period between trigger pulses at tunnel diode A1CR8 is 1 second, the sweep gate generator will not free run during the first 800 milliseconds but will free run during the remaining 200 milliseconds until another trigger pulse is present. If the period between trigger pulses is less than approximately 800 milliseconds, the sweep-gate generator will respond to each trigger. The period of the free-running ramp is determined by the SWEEP TIME/DIV switch (sweep time plus hold-off).

## 4-65. SINGLE OPERATION.

4-66. When SINGLE MODE is selected, the emitter of transistor A1Q30 will change to approximately +15 volts. This prevents the length Schmitt circuit from switching to the unstable state at the end of the sweep ramp. There are two means available to switch the length Schmitt circuit and rearm the time base. Manual RESET with a front-panel pushbutton, electrical reset with a rear-panel input (EXT RESET on Model 183A/B oscilloscope). When a positive pulse is applied to the reset regenerative switch, a negative transition occurs at the emitter of transistor A1Q28 which produces a negative transition at the emitter of transistor A1Q28 which produces a negative transition at the emitter of transistor A1Q30. This transition will reverse bias diode A1CR33 and current through resistor R111 will switch the length Schmitt circuit and rearm the dual tunnel diode trigger circuit.

4-67. When the dual tunnel diode trigger circuit is reset, the RESET indicator is turned on. Prior to reset, transistor A1Q3 is turned off and no current will flow through transistor A1Q3. The bias on the base of transistor A1Q3 is the same as on the base of transistor A1Q2 and no current will flow through transistor A1Q2. When the control reset circuit is armed, the bias on the base of transistors A1Q3 and Q2 will permit current to flow in both transistors. With transistor A1Q2 conducting, the current will bypass resistor A1R63 through transistor A1Q2 and will cause the voltage level at the collector of A1Q2 to decrease. The voltage drop across A1R61 will increase until DS1 lights. Indicator DS1 will stay on during the arming time and gate time. This indication occurs in all modes but is particularly useful in SINGLE MODE. The indicator will light when the circuit is rearmed and ready to accept a new trigger.

sary, the time base will automatically operation.

r signal period is less than 0.2 second or ater than 5 hertz, the monostable ot switch states. The free-run lock out ue to lock out free-run operation. If the iod is greater than 0.2 second or a n 5 hertz, the monostable multivibrator This will establish a voltage level on the stor A1U3Q5 so that transistor A1U4Q3 en hold off ends, restoring free-run

llustrates AUTO operation. If the period lses at tunnel diode A1CR8 is 1 second, erator will not free run during the first but will free run during the remaining until another trigger pulse is present. If tween trigger pulses is less than milliseconds, the sweep-gate generator h trigger. The period of the free-running ed by the SWEEP TIME/DIV switch old-off).

## OPERATION.

LE MODE is selected, the emitter of will change to approximately +15 volts. length Schmitt circuit from switching to at the end of the sweep ramp. There are le to switch the length Schmitt circuit time base. Manual RESET with a tton, electrical reset with a rear-panel T on Model 183A/B oscilloscope). When applied to the reset regenerative switch, ion occurs at the emitter of transistor uces a negative transition at the emitter 8 which produces a negative transition transistor A1Q30. This transition will A1CR33 and current through resistor e length Schmitt circuit and rearm the rigger circuit.

al tunnel diode trigger circuit is reset, or is turned on. Prior to reset, transistor ff and no current will flow through he bias on the base of transistor A1Q3 the base of transistor A1Q2 and no through transistor A1Q2. When the it is armed, the bias on the base of nd Q2 will permit current to flow in With transistor A1Q2 conducting, the ss resistor A1R63 through transistor se the voltage level at the collector of . The voltage drop across A1R61 will lights. Indicator DS1 will stay on during d gate time. This indication occurs in all cularly useful in SINGLE MODE. The when the circuit is rearmed and ready ger.

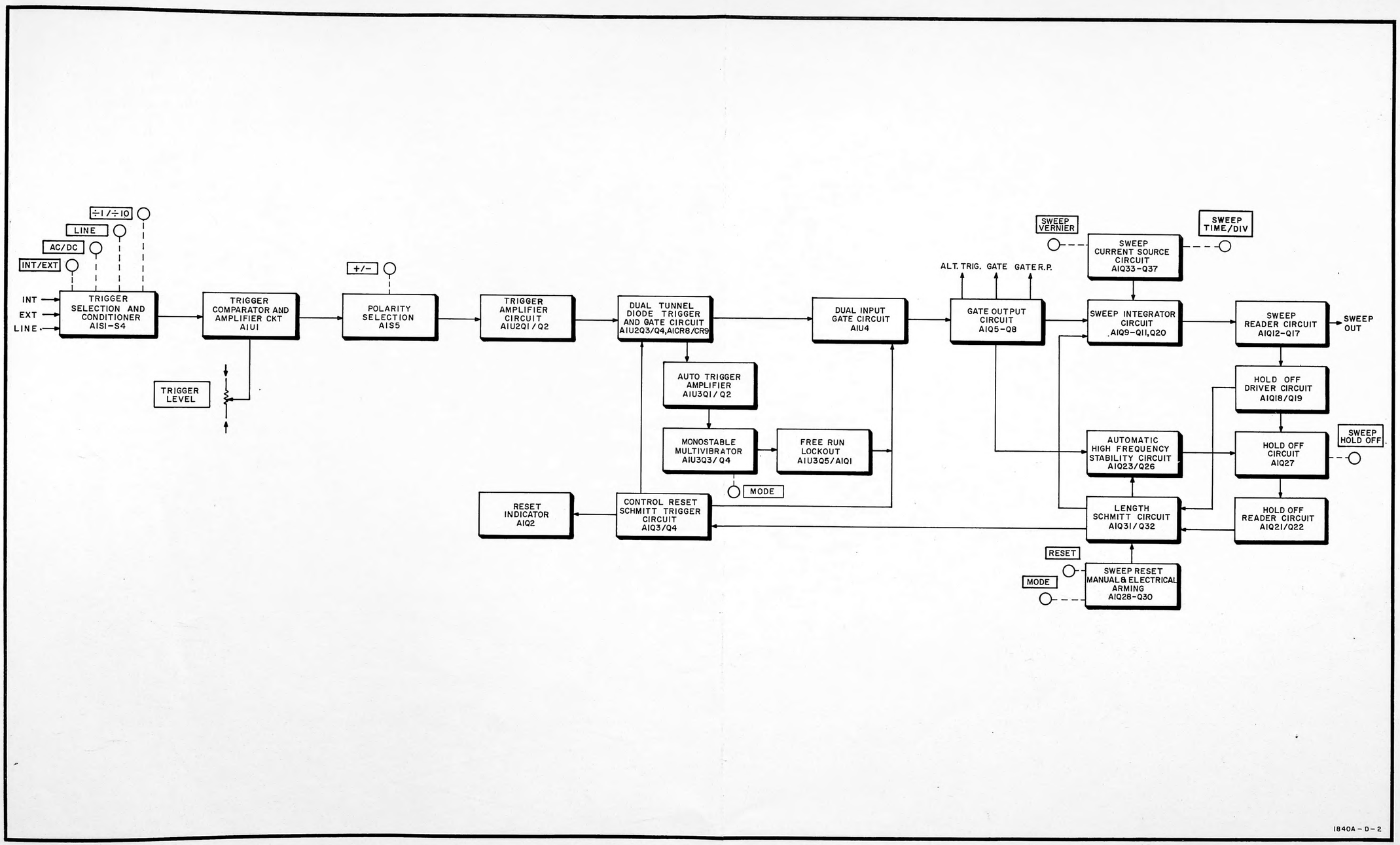



Figure 4-7. Overall Block Diagram

Table 5-1. Required Test Equipment

| Recommended Instrument | | Required Characteristics | Use |
|---|---|---|---|
| Type | Model | | |
| Signal Generator | HP Model 651B | 10 Hz to 10 MHz | Internal Triggering<br>External Triggering<br>Trigger Balance |
| VHF Oscillator | HP Model 3200B | 10 MHz to 500 MHz | Internal Triggering<br>External Triggering |
| Time Mark Generator | Tektronix Type 184 | 0.1 sec to 10 nsec @ 200 MV pk-pk | Sweep Time Check<br>Sweep Vernier Check<br>Sweep Time Adjustment |
| Digital Voltmeter | HP Model 3439A with 3443A | .05% accuracy | Triggering (HF Stability) Adjustment |
| RF Voltmeter | HP Model 3406A | >500 MHz 5% accuracy | External Triggering |

Accessory Required:

(1) Power Divider GR Type 874
(1) 50-ohm Tee HP Model 11063A
(1) 50-ohm Termination HP Part No. 0950-0090

# SECTION V

# PERFORMANCE CHECK AND ADJUSTMENTS

## 5-1. INTRODUCTION.

5-2. This section provides a performance check and the calibration procedure for the HP Model 1840A Time Base. Refer to Section VIII for troubleshooting information, schematics, and component identification.

## 5-3. TEST EQUIPMENT.

5-4. Test equipment required for checking and maintaining performance is listed in Table 5-1. Test equipment having similiar characteristics to that listed in Table 5-1 may be substituted. Recently calibrated equipment should be used when performing these checks. Use a non-metallic alignment tool for making the required adjustments.

## 5-5. PERFORMANCE CHECK.

5-6. The performance check verifies whether or not the Model 1840A is operating within the specifications. This check may be used as part of an incoming quality control inspection, as a periodic operational check, or after repairs and/or adjustments have been made. Recently calibrated test equipment should be used when performing this check.

5-7. A performance check record form is included in this section. As the initial check is accomplished, the actual readings should be entered on the form. The form should then be removed from the manual and filed in a safe place, so that readings taken at later dates can be compared to original performance.

5-8. The performance check should be done in the same sequence as shown. Successive steps are dependent upon control settings and results of previous steps.

### 5-9. PRELIMINARY SET-UP.

5-10. Lock plug-ins together and install in HP 183-series oscilloscope mainframe. Apply power and allow a 15-minute warm-up.

### 5-11. INITIAL CONTROL SETTINGS.

a. Set HP 183-series oscilloscope controls:

X1/X10 ..... X1
INT/EXT ..... INT

b. Set HP Model 1830A Dual Channel Vertical Amplifier controls:

DISPLAY ..... A
SYNC ..... CH A
CH A ON/OFF ..... ON

c. Set HP Model 1840A Time Base controls:

EXT/INT ..... INT
AC/DC ..... DC
÷10/÷1 ..... ÷1
NORM/AUTO ..... NORM
LINE ..... Button out
SINGLE ..... Button out
SWEEP HOLD-OFF ..... NORM
SWEEP VERNIER ..... CAL

### 5-12. INTERNAL TRIGGERING CHECK.

a. Connect output of Signal Generator or VHF Oscillator to Channel A Input of Vertical Amplifier.

Note

To check triggering over the entire frequency range, several signal generators may be required. Two signal generators are recommended in Table 5-1.

b. Adjust Signal Generator or VHF Oscillator amplitude and/or Channel A Vernier for 1 div vertical deflection.

c. Vary Signal Generator or VHF frequency from 10 Hz to 250 MHz, maintaining 1 div of vertical amplitude.

d. Adjust TRIGGER LEVEL control to obtain a stable display.

e. Disconnect Signal Generator.

### 5-13. EXTERNAL TRIGGERING CHECK.

a. Connect Signal Generator or VHF Oscillator output to Power Divider. Connect outputs of Power Divider to Channel A Input and EXT INPUT of HP Model 1840A.

b. Set EXT/INT control to EXT.

c. Vary Signal Generator or VHF Oscillator frequency from 10 Hz to 250 MHz. Maintain 20 mV of amplitude as observed on HP Model 183A/B.

d. Adjust TRIGGER LEVEL control to obtain a stable display at selected frequencies.

e. Disconnect Signal Generator or VHF Oscillator.

f. Set VHF Oscillator frequency to 500 MHz. Connect output of VHF Oscillator to 50-ohm termination with RF Voltmeter as shown in Figure 5-1.

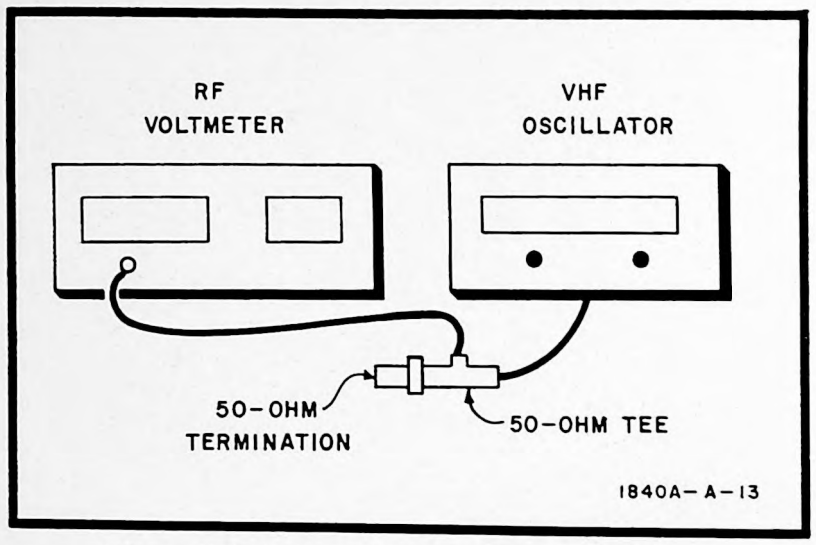



Figure 5-1. External Trigger Check Test Set-up

g. Adjust amplitude of VHF Oscillator for 35.3 mV RMS or 100 mV pk-pk.

h. Disconnect VHF Oscillator from 50-ohm termination and connect to Power Divider as in step a.

i. Adjust TRIGGER LEVEL control to obtain a stable display.

j. Disconnect VHF Oscillator.

**5-14. AUTO OPERATION CHECK.**

a. Set NORM/AUTO MODE switch to AUTO.

b. Rotate SWEEP TIME/DIV switch.

c. Baseline should be present in all sweep speeds.

**5-15. SWEEP TIME CHECK.**

a. Connect output of Time Mark Generator to Channel A Input.

b. Set EXT/INT control to INT and NORM/AUTO to NORM.

c. Set Time Mark Generator and SWEEP TIME/DIV switch according to Table 5-2. Adjust TRIGGER LEVEL control as necessary to obtain a stable display.

d. Adjust HORIZONTAL POS control on oscilloscope to align first marker with left edge of graticule.

e. The 11th or 21st marker (according to Table 5-2) should be within 1.5 minor divisions of right edge of graticule.

Note

The results of checks made in this paragraph are determined by calibration accuracy of both the Model 1840A and the oscilloscope mainframe.

Table 5-2. Sweep Performance Check

| SWEEP TIME/DIV | TIME MARK GENERATOR | MARKERS IN 10 DIV |
|---|---|---|
| .1 sec | .1 sec | 11 |
| 50 msec | 50 ms | 11 |
| 20 msec | 10 ms | 21 |
| 10 msec | 10 ms | 11 |
| 5 msec | 5 ms | 11 |
| 2 msec | 1 ms | 21 |
| 1 msec | 1 ms | 11 |
| .5 msec | .5 ms | 11 |
| .2 msec | .1 ms | 21 |
| .1 msec | .1 ms | 11 |
| 50 usec | 50 us | 11 |
| 20 usec | 10 us | 21 |
| 10 usec | 10 u us | 11 |
| 5 usec | 5 us | 11 |
| 2 usec | 1 us | 21 |
| 1 usec | 1 us | 11 |
| .5 usec | .5 us | 11 |
| .2 usec | .1 us | 21 |
| .1 usec | .1 ns | 11 |
| .05 usec | 50 ns | 11 |
| .02 usec | 20 ns | 11 |
| .01 usec | 10 ns | 11 |

**5-16. SWEEP VERNIER CHECK.**

a. Set SWEEP TIME/DIV switch to 50 uSEC/DIV and Time Mark Generator to 0.5 msec markers.

b. Rotate SWEEP VERNIER control fully ccw.

c. Any two markers should be displayed in less than 4 div and UNCAL indicator should light.

d. Disconnect Time Mark Generator and rotate SWEEP VERNIER to CAL.

Note

The results of checks made in this paragraph are determined by calibration accuracy of both the Model 1840A and the oscilloscope mainframe.

CUT ALONG DOTTED LINE

## MODEL 1840A PERFORMANCE CHECK RECORD

Serials Prefixed:

| Check | Min | Indication | Max |
|---|---|---|---|
| Internal Triggering Check | Stable display | | |
| External Triggering Check | Stable display | | |
| Auto Operation Check | Stable display | | |
| Sweep Time Check | | | |
| .1 sec | 9.7 div | ——— | 10.3 div |
| 50 msec | 9.7 div | ——— | 10.3 div |
| 20 msec | 9.7 div | ——— | 10.3 div |
| 10 msec | 9.7 div | ——— | 10.3 div |
| 5 msec | 9.7 div | ——— | 10.3 div |
| 2 msec | 9.7 div | ——— | 10.3 div |
| 1 msec | 9.7 div | ——— | 10.3 div |
| .5 msec | 9.7 div | ——— | 10.3 div |
| .2 msec | 9.7 div | ——— | 10.3 div |
| .1 msec | 9.7 div | ——— | 10.3 div |
| 50 usec | 9.7 div | ——— | 10.3 div |
| 20 usec | 9.7 div | ——— | 10.3 div |
| 10 usec | 9.7 div | ——— | 10.3 div |
| 5 usec | 9.7 div | ——— | 10.3 div |
| 2 usec | 9.7 div | ——— | 10.3 div |
| 1 usec | 9.7 div | ——— | 10.3 div |
| .5 usec | 9.7 div | ——— | 10.3 div |
| .2 usec | 9.7 div | ——— | 10.3 div |
| .1 usec | 9.7 div | ——— | 10.3 div |
| .05 usec | 9.7 div | ——— | 10.3 div |
| .02 usec | 9.7 div | ——— | 10.3 div |
| .01 usec | 9.7 div | ——— | 10.3 div |
| Sweep Vernier Check | | | 4 div |

## 5-17. ADJUSTMENTS.

5 18. The following paragraphs outline procedures for calibrating the HP Model 1840A. Required test equipment is listed in Table 5-1. Other recently calibrated test equipment with similar characteristics may be substituted if necessary. Adjustment locations are illustrated in Figure 5-2.

### 5-19. PRELIMINARY SETUP.

5-20. Lock the plug-ins together and install (refer to Section II) in a calibrated HP Model 183A/B Oscilloscope. Apply power and allow a 15-minute warm-up before proceeding. To gain access to adjustments, the lower right side panel of the HP Model 183A or the right side panel of the HP Model 183B must be removed.

### 5-21. INITIAL CONTROL SETTINGS.

a. Set HP Model 183-series Oscilloscope controls:

X1/X10 ..... X1
INT/EXT ..... INT

b. Set HP Model 1830A Dual Channel Vertical Amplifier controls:

DISPLAY ..... A
SYNC ..... CH A
CH A ON/OFF ..... ON

c. Set HP Model 1840A Time Base controls:

EXT/INT ..... INT
AC/DC ..... AC
SWEEP TIME/DIV ..... 0.5 msec
÷10/÷1 ..... ÷1
NORM/AUTO ..... NORM
LINE ..... Button out
SIGNAL ..... Button out
SWEEP HOLD OFF ..... NORM
SWEEP VERNIER ..... CAL

### 5-22. TRIGGER BALANCE ADJUSTMENT.

a. Connect output of Signal Generator (HP Model 651B) to Channel A Input.

b. Set frequency to 100 kHz and amplitude for 0.5 div vertical deflection on CRT.

c. Adjust Trigger Balance A1R19 for a triggered display on CRT (may not be stable).

d. Disconnect Signal Generator.

### 5-23. TRIGGER SENSITIVITY ADJUSTMENT.

a. Rotate A1R43 fully ccw.

b. Adjust TRIGGER LEVEL until trace appears.

c. Slowly adjust A1R43 cw until trace disappears.

d. Repeat steps b and c until no trace will appear at any position of TRIGGER LEVEL in NORM sweep mode. Note setting of A1R43, rotate A1R43 an additional 10 degrees cw.

### 5-24. SWEEP TIME ADJUSTMENT.

a. Connect Time Mark Generator to Channel A Input.

b. Set Time Mark Generator and SWEEP TIME/DIV switch according to Table 5-3. Set Channel A VOLTS/DIV for 3 to 5 div of vertical display on CRT. In each position, adjust TRIGGER LEVEL control to obtain stable display.

c. Adjust HORIZONTAL POS control on oscilloscope to align first marker with left edge of graticule.

e. Using Table 5-3, adjust appropriate timing adjustment to set either 11th or 21st markers on right edge of graticule.

f. Disconnect Time Mark Generator.

### 5-25. TRIGGER STABILITY (HF STABILITY) ADJUSTMENT.

a. Set Channel A VOLTS/DIV to .01 and SWEEP TIME/DIV to .01 usec.

b. Connect VHF Oscillator to Channel A Input.

c. Adjust VHF Oscillator frequency for 500 MHz and amplitude for 1 div of vertical display on CRT. Adjust TRIGGER LEVEL for stable display.

d. Connect positive lead of Digital Voltmeter to drain of FET A1Q26, and negative lead to ground.

e. Rotate capacitor A1C20 cw slowly through a full turn, noting highest voltage level.

f. Set capacitor A1C20 to highest indication. Then slowly rotate A1C20 cw until indication drops 200 mV from peak value.

g. Disconnect VHF Oscillator and Digital Voltmeter.

**IIVITY ADJUSTMENT.**

y ccw.

LEVEL until trace appears.

43 cw until trace disappears.

d c until no trace will appear at
R LEVEL in NORM sweep mode.
, rotate A1R43 an additional 10

**USTMENT.**

k Generator to Channel A Input.

enerator and SWEEP TIME/DIV
5-3. Set Channel A VOLTS/DIV
display on CRT. In each position,
control to obtain stable display.

AL POS control on oscilloscope
left edge of graticule.

3, adjust appropriate timing
11th or 21st markers on right

ark Generator.

**TABILITY (HF STABILITY)**

OLTS/DIV to .01 and SWEEP

llator to Channel A Input.

ator frequency for 500 MHz and
vertical display on CRT. Adjust
able display.

ead of Digital Voltmeter to drain
tive lead to ground.

A1C20 cw slowly through a full
ge level.

C20 to highest indication. Then
until indication drops 200 mV

scillator and Digital Voltmeter.

Table 5-3. SWEEP Timing Adjustments

| SWEEP TIME/DIV | TIME MARK GENERATOR | Markers in 10 div | Timing Adjustment |
|---|---|---|---|
| .1 sec | .1 sec | 11 | A1R152 |
| 50 msec | 50 ms | 11 | |
| 20 msec | 10 ms | 21 | |
| 10 msec | 10 ms | 11 | |
| 5 msec | 5 ms | 11 | |
| 2 msec | 1 ms | 21 | |
| 1 msec | 1 ms | 11 | |
| .5 msec | .5 ms | 11 | A1R151 |
| .2 msec | .1 ms | 21 | |
| .1 msec | .1 ms | 11 | |
| 50 usec | 50 us | 11 | |
| 20 usec | 10 us | 21 | |
| 10 usec | 10 us | 11 | |
| 5 usec | 5 us | 11 | A1R150 |
| 2 usec | 1 us | 21 | |
| 1 usec | 1 us | 11 | |
| .5 usec | .5 us | 11 | |
| .2 usec | .1 us | 21 | |
| .1 usec | .1 us | 11 | |
| .05 usec | .05 us | 11 | A1C14 |
| .02 usec | .02 us | 11 | |
| .01 usec | .01 us | 11 | |

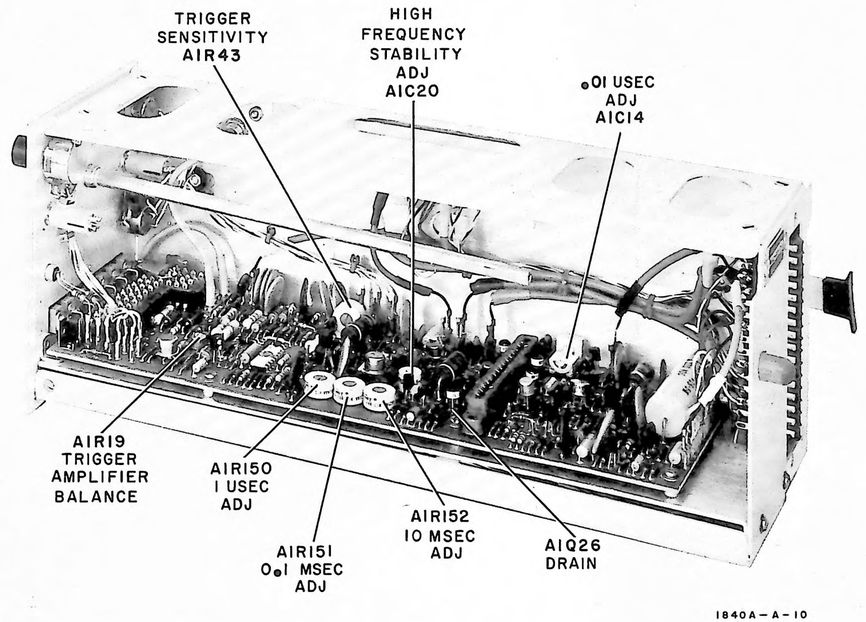



Figure 5-2. Adjustment Location

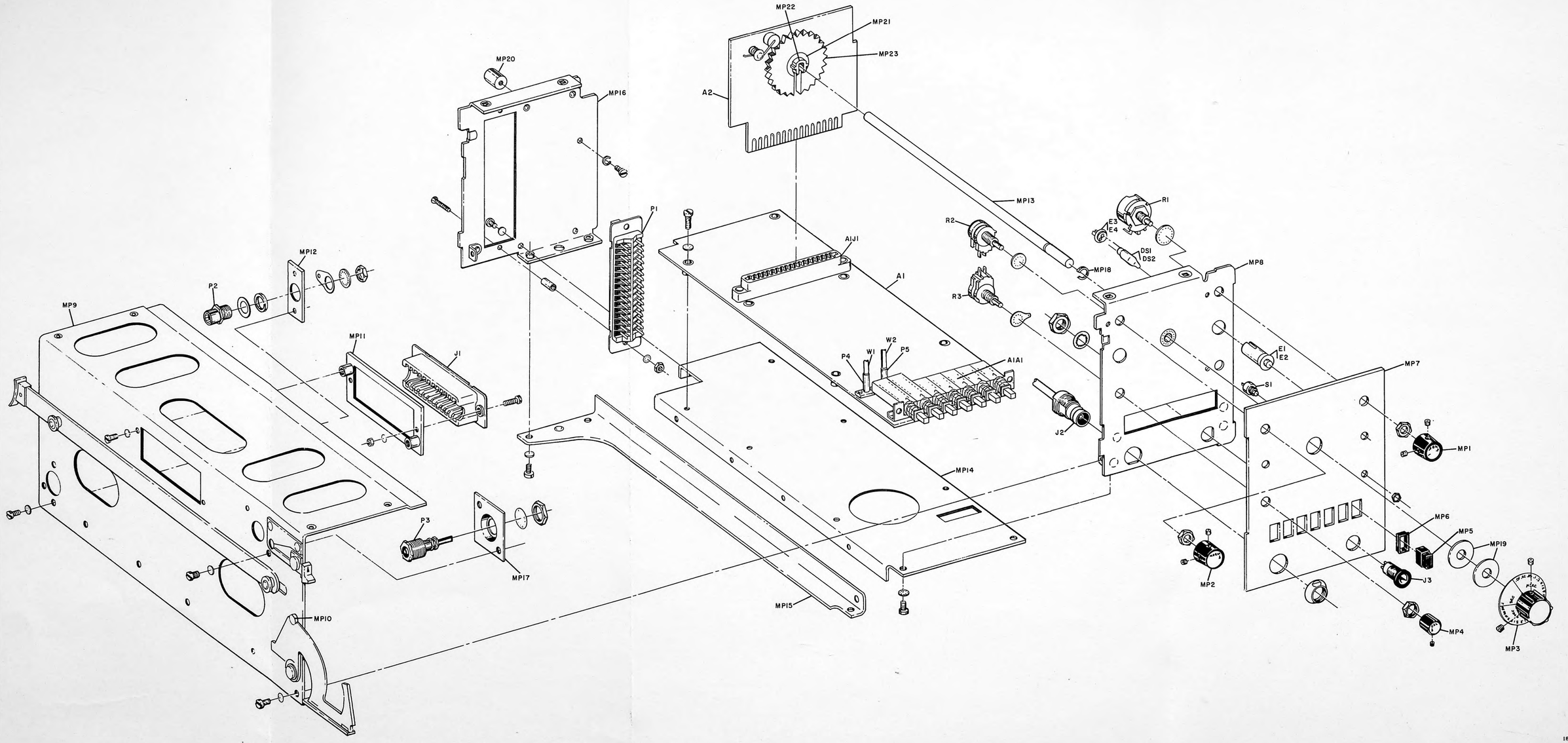



Figure 6-1. Mechanical Parts Location

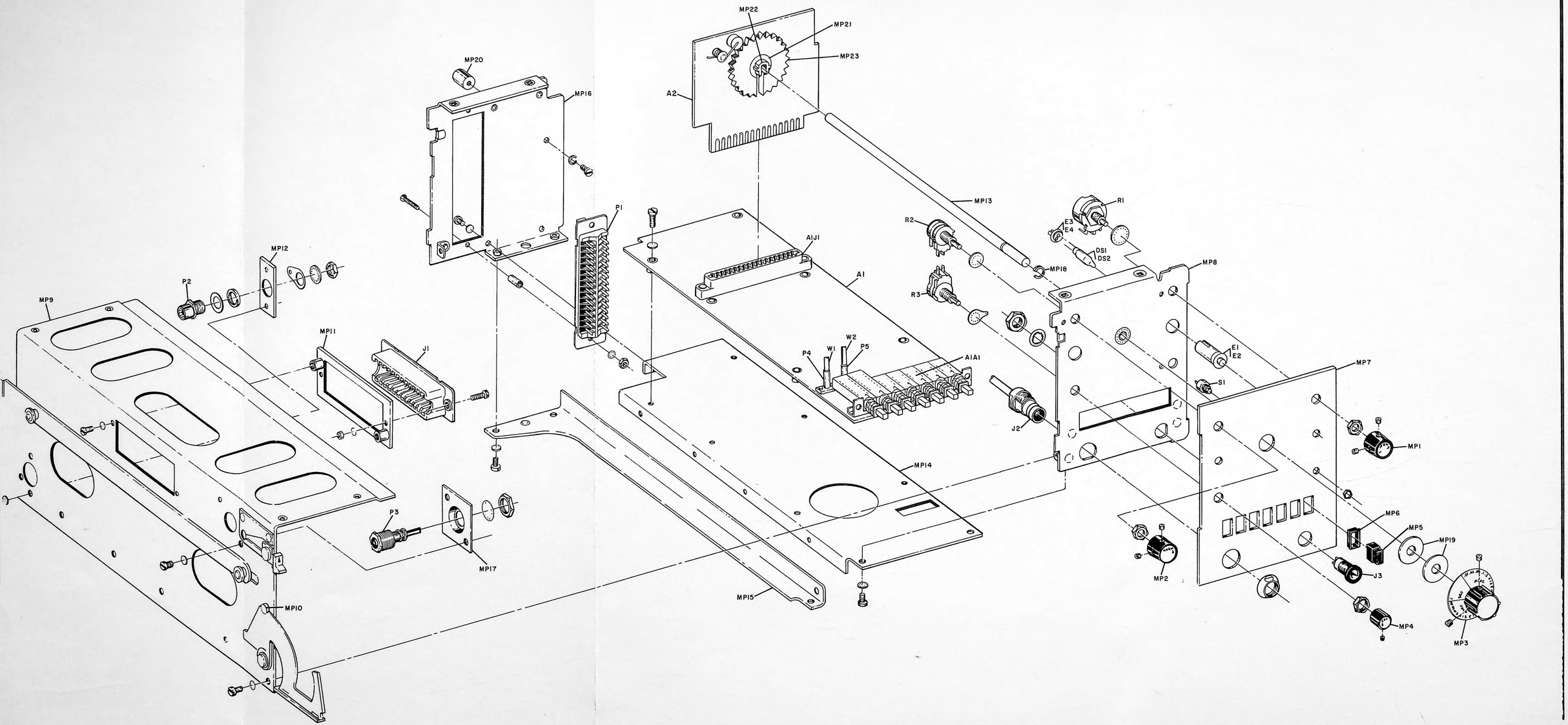



Figure 6-1. Mechanical Parts Location

## Table 6-1. Reference Designators And Abbreviations

### REFERENCE DESIGNATORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | = assembly | E | = misc. electronic part | M | = meter | TB | = terminal board |
| AT | = attenuator, resistive termination | F | = fuse | MP | = mechanical part | TP | = test point |
| B | = motor, fan | FL | = filter | P | = plug | U | = microcircuit(non-repairable) |
| C | = capacitor | H | = hardware | PS | = power supply | V | = vacuum tube, neon bulb, photocell, etc. |
| CP | = coupling | IC | = integrated circuit | Q | = transistor | VR | = voltage regulator (diode) |
| CR | = diode | J | = jack | R | = resistor | W | = cable |
| DL | = delay line | K | = relay | RT | = thermistor | X | = socket |
| DS | = device signaling (lamp) | L | = inductor | S | = switch | Y | = crystal |
| | | LS | = speaker | T | = transformer | | |

### ABBREVIATIONS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | = ampere(s) | Ge | = germanium | minat | = miniature | s-b | = slow-blow |
| ampl | = amplifier(s) | G | = giga ($10^9$) | mom. | = momentary | Se | = selenium |
| assy | = assembly | gl | = glass | mtg | = mounting | sect | = section(s) |
| bd | = board(s) | grd | = ground(ed) | my. | = mylar | semicon | = semiconductor(s) |
| bp | = bandpass | H | = henry(ies) | n | = nano ($10^{-9}$) | Si | = silicon |
| c | = centi ($10^{-2}$) | Hg | = mercury | n/c | = normally closed | sil | = silver |
| car. | = carbon | hr | = hour(s) | Ne | = neon | sl | = slide |
| ccw | = counterclockwise | HP | = Hewlett-Packard | n/o | = normally open | sp | = single pole |
| cer | = ceramic | Hz | = hertz | npo | = negative positive zero (zero temperature coefficient) | spl | = special |
| coax. | = coaxial | if. | = intermediate freq | nsr | = not separately replaceable | st | = single throw |
| coef | = coefficient | impg | = impregnated | obd | = order by description | std | = standard |
| com | = common | incd | = incandescent | ox | = oxide | Ta | = tantalum |
| comp | = composition | incl | = include(s) | p | = pico ($10^{-12}$) | td | = time delay |
| conn | = connector(s) | ins | = insulation(ed) | pc | = printed (etched) circuit(s) | TD | = tunnel diode(s) |
| CRT | = cathode-ray tube | int | = internal | PGM | = program | tgl | = toggle |
| cw | = clockwise | k | = kilo ($10^3$) | piv | = peak inverse voltage(s) | Ti | = titanium |
| d | = deci ($10^{-1}$) | lb | = pound(s) | p/o | = part of | tol | = tolerance |
| depc | = deposited carbon | lev | = lever | poly | = polystyrene | trim | = trimmer |
| dp | = double pole | lin | = linear taper | porc | = porcelain | u | = micro ($10^{-6}$) |
| dt | = double throw | log. | = logarithmic taper | pos | = position(s) | V | = volt(s) |
| elect. | = electrolytic | lpf | = low-pass filter(s) | pot. | = potentiometer(s) | var | = variable |
| encap | = encapsulated | m | = milli ($10^{-3}$) | pk-pk | = peak-to-peak | W | = watt(s) |
| ext | = external | M | = mega ($10^6$) | rect | = rectifier(s) | w/ | = with |
| F | = farad(s) | metflm | = metal film | rf | = radio frequency | w/o | = without |
| fet | = field-effect transistor(s) | metox | = metal oxide | | | wVdc | = dc working volt(s) |
| fxd | = fixed | | | | | ww | = wirewound |

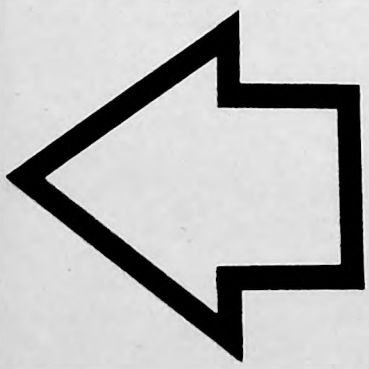


Figure 6-1 Located Inside Fold

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section contains information for ordering replaceable parts for the instrument. Table 6-2 lists parts in alphanumeric order by reference designations and provides the following information for each item:

a. HP Part Number.

b. total quantity (TQ) used in instrument; given only first time a part number is listed.

c. description of part; refer to Table 6-1 for list of reference designators and abbreviations.

6-3. Mechanical parts are listed in Table 6-2 with MP designators and identified in Figure 6-1.

## 6-4. ORDERING INFORMATION.

6-5. To order a replacement part from Hewlett-Packard Company, address the order or inquiry to the nearest Hewlett-Packard Sales/Service Office (list at the rear of manual) and supply the following information:

a. HP Part Number of item (s).

b. model number and eight-digit serial number of instrument.

6-6. To order a part not listed in the table, provide the following information:

a. model number and eight-digit serial number of instrument.

b. description of part, including function and location.

6-7. Component description given in Table 6-2 are as complete as possible to assist in obtaining replacement parts from manufacturers other than HP. However, many parts are manufactured only by HP, or are produced by other manufacturers to HP proprietary specifications and are therefore available only from HP. Actual manufacturer and manufacturers part number for non-HP parts will be supplied upon request. Contact the nearest HP Sales/service Office.

Table 6-2. Replaceable Parts

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| | | | **CHASSIS PARTS** |
| A1 | 01840-66501 | 1 | A: Sweep Board Assy |
| A2 | 01840-66502 | 1 | A: Sweep Switch Assy |
| DS1 | 2140-0018 | 2 | DS: Neon (uncal) |
| DS2 | 2140-0018 | | DS: Neon (reset) |
| E1 | 5060-0451 | 2 | E: Lens (uncal) |
| E2 | 5060-0451 | | E: Lens (reset) |
| E3 | 5060-0458 | 2 | E: header lamp (uncal) |
| E4 | 5060-0458 | | E: header lamp (reset) |
| J1 | 1251-0054 | 1 | J: connector 24 pin |
| J2 | | 1 | NSR: BNC p/o W1 (ext input) |
| J3 | 5060-0467 | 1 | J: connector 3 pin (probe power) |
| L1 | 01840-66001 | 2 | L: fxd 100 uH 10% |
| L2 | 01840-66001 | | L: fxd 100 uH 10% |
| MP1 | 01821-67401 | 1 | Knob: (level) |
| MP2 | 01820-67402 | 1 | Knob: (hold off) |
| MP3 | 01840-67402 | 1 | Knob: (sweep time div) |
| MP4 | 01803-67407 | 1 | Knob: (vernier) |
| MP5 | 00183-67406 | 7 | Knob: (trigger and mode functions) |
| MP6 | 0370-0451 | 7 | Bezel: (trigger and mode functions) |
| MP7 | 01840-00204 | 1 | Panel: front |
| MP8 | 01840-00201 | 1 | Panel: sub |
| MP9 | 01840-60101 | 1 | Chassis Assy: right |
| MP10 | 01821-43101 | 1 | Guide: latch |
| MP11 | 01821-01204 | 1 | Bracket: jack (J1) |
| MP12 | 01821-04101 | 1 | Bracket: plug (P2) |
| MP13 | 01840-23701 | 1 | Shaft: (sweep time/div) |
| MP14 | 01840-01201 | 1 | Bracket: ground plane |
| MP15 | 01840-04701 | 1 | Bracket: plug-in support |
| MP16 | 01840-00203 | 1 | Panel: rear |
| MP17 | 01840-01202 | 1 | Bracket: plug (P3) |
| MP18 | 3130-0012 | 1 | Retainer: "C" ring |
| MP19 | 3050-0481 | 1 | Washer: teflon |
| MP20 | 01840-26101 | 1 | Pin: lock out |
| MP21 | 0510-1101 | 1 | Ring: retainer |
| MP22 | 3130-0339 | 1 | Rotor: male |
| MP23 | 3130-0340 | 1 | Rotor: female |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| P1 | 1251-0136 | 1 | P: connector 32 pin |
| P2 | 1250-0898 | 1 | P: connector (int sync input Model 180A-series vert amps.) |
| P3 | | | NSR: connector p/o 2 (int sync input Model 183A-series vert. amps.) |
| P4 | | | NSR: connector p/o W1, (W1 to printed circuit board) |
| P5 | | | NSR: connector p/p W2, (W2 to printed circuit board) |
| R1 | 2100-2919 | 1 | R: var cermet 200 kilohms 20% 2W |
| R2 | 2100-2924 | 1 | R: var carbon comp 10 kilohms 20% 1/2W |
| R3 | 2100-2923 | 1 | R: var carbon comp 100 kilohms 10% 1/2W linear |
| R4 | 0757-0454 | 2 | R: fxd metflm 33.2 kilohms 1% 1/8W |
| R5 | 0757-0469 | | R: fxd metflm 150 kilohms 1% 1/8W |
| S1 | 3101-0044 | 1 | S: pushbutton |
| W1 | 01840-61604 | 1 | W: coax. cable (ext trigger input) includes J2 and P4 |
| W2 | 01840-61605 | 1 | W: coax. cable (int. trigger 183-series vert amp.) includes P3 and P5 |
| W3 | 01840-61607 | 1 | W: coax, cable (int. trigger, 180-series vert amps.) |
| W4 | 01840-61609 | 1 | W: coax. cable (alt. trigger to 183-series vert amps.) |
| W5 | 01840-61608 | 1 | W: coax. cable (sweep out) |
| W6 | 01840-61606 | 1 | W: coax. cable (ext reset) |
| W7 | 01840-61602 | 1 | W: cable (reset and level) |
| W8 | 01840-61603 | 1 | W: cable (vernier and hold off) |
| W9 | 01840-61601 | 1 | W: cable (includes W10 through W13) |
| W10 | 01840-61611 | 1 | W: coax. cable (gate to mainframe) |
| W11 | 01840-61612 | 1 | W: coax. cable (gate to rear panel) |
| W12 | 01840-61613 | 1 | W: coax. cable (alt. trigger for 180-series Oscilloscopes from mainframes to vert amp) |
| W13 | 01840-61610 | 1 | W: coax. cable (chopped blanking from mainframe to vert amp) |
| | | | **A1** |
| A1 | 01840-66501 | 1 | A: Main board assy |
| A1A1 | 3101-1269 | 1 | A: Switch, pushbutton |
| A1C1 | 0160-0134 | 2 | C: fxd mica 220 pF 5% 300 wVdc |
| A1C2 | 0160-0127 | 2 | C: fxd cer 1 uF 20% 25 wVdc |
| A1C3 | 0160-0127 | | C: fxd cer 1 uF 20% 25 wVdc |
| A1C4 | 0150-0096 | 13 | C: fxd cer 0.05 uF −20 +80% 100 wVdc |
| A1C5 | 0150-0096 | | C: fxd cer 0.05 uF −20 +80% 100 wVdc |
| A1C6 | 0150-0096 | | C: fxd cer 0.05 uF −20 +80% 100 wVdc |
| A1C7 | 0180-0106 | 1 | C: fxd Ta 60 uF 20% 6 wVdc |
| A1C8 | 0150-0063 | 1 | C: fxd cer 10 pF ±0.5 pF 500 wVdc |
| A1C9 | 0140-0209 | 1 | C: fxd mica 5 pF 10% 500 wVdc |
| A1C10 | 0150-0081 | 7 | C: fxd cer 0.01 uF −20 +80% 500 wVdc |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1C11 | 0150-0050 | 7 | C: fxd cer 1000 pF –20 +80% 600 wVdc |
| A1C12 | 0150-0050 | | C: fxd cer 1000 pF –20 +80% 600 wVdc |
| A1C13 | 0160-2200 | 1 | C: fxd mica 43 pF 5% 300 wVdc |
| A1C14 | 0121-0434 | 1 | C: var air 2–19.3 pF 350 Vrms |
| A1C15 | 0150-0050 | | C: fxd cer 1000 pF –20 +80% 600 wVdc |
| A1C16 | 0180-0230 | 3 | C: fxd Ta 1 uF 20% 50 wVdc |
| A1C17 | 0160-0134 | | C: fxd mica 220 pF 5% 300 wVdc |
| A1C18 | 0150-0081 | | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C19 | 0140-0203 | 1 | C: fxd mica 30 pF 5% 500 wVdc |
| A1C20 | 0121-0061 | 1 | C: var cer 5.5–18 pF 300 wVdc |
| A1C21 | 0180-1743 | 1 | C: fxd Ta 0.1uF 10% 35 wVdc |
| A1C22 | 0180-0230 | | C: fxd Ta 1 uF 20% 50 wVdc |
| A1C23 | 0160-2307 | 1 | C: fxd mica 47 pF 5% 300 wVdc |
| A1C24 | 0150-0096 | | C: fxd cer 0.05 uF –20% +80% wVdc |
| A1C25 | 0160-3354 | 1 | C: fxd met poly car 10 uF –15 + 5% 100 wVdc |
| A1C26 | 0150-0081 | | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C27 | 0150-0096 | | C: fxd cer 0.05 uF –20% +80% 100 wVdc |
| A1C28 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C29 | 0180-0230 | | C: fxd Ta 1 uF 20% 50 wVdc |
| A1C30 | 0180-0374 | 3 | C: fxd Ta 10 uF 10% 20 wVdc |
| A1C31 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C32 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C33 | 0180-0374 | | C: fxd Ta 10 uF 10% 20 wVdc |
| A1C34 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C35 | 0150-0081 | 1 | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C36 | 0150-0050 | | C: fxd cer 1000 pF –20 +80% 600 wVdc |
| A1C37 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C38 | 0180-0374 | | C: fxd Ta 10 uF 10% 20 wVdc |
| A1C39 | 0150-0050 | | C: fxd cer 1000 pF –20 +80% 600 wVdc |
| A1C40 | 0150-0081 | | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C41 | 0150-0081 | | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C42 | 0150-0081 | | C: fxd cer 0.01 uF –20 +80% 500 wVdc |
| A1C43 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C44 | 0160-0153 | 1 | C: fxd mylar 1000 pF 10% 200 wVdc |
| A1C45 | 0150-0096 | | C: fxd cer 0.05 uF –20 +80% 100 wVdc |
| A1C46 | 0140-0149 | | C: fxd mica 470 pF 5% 300 wVdc |
| A1C47 | 0160-3365 | 1 | C: fxd cer 6.8 pF 5% 100 wVdc |
| A1C48 | 0150-0096 | | C: fxd cer 0.05 uF –20+80% 100 wVdc |
| A1C49 | 0150-0050 | | C: fxd cer 1000 pF –20+80% 600 wVdc |
| A1C50 | 0160-2308 | 1 | C: fxd mica 36 pF 5% 300 wVdc |
| A1C51 | 0150-0050 | | C: fxd cer 1000 pF –20+80% 600 wVdc |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1CR1 | 1901-0040 | 28 | CR: Si |
| A1CR2 | 1901-0179 | 7 | CR: Si |
| A1CR3 | 1901-0179 | | CR: Si |
| A1CR4 | 1901-0179 | | CR: Si |
| A1CR5 | 1901-0179 | | CR: Si |
| A1CR6 | 1901-0179 | | CR: Si |
| A1CR7 | 1901-0179 | | CR: Si |
| A1CR8 | 1912-0028 | 2 | CR: Ge 10 ma |
| A1CR9 | 1912-0028 | | CR: Ge 10 ma |
| A1CR10 | 1901-0040 | | CR: Si |
| A1CR11 | 1901-0040 | | CR: Si |
| A1CR12 | 1901-0040 | | CR: Si |
| A1CR13 | 1901-0040 | | CR: Si |
| A1CR14 | 1901-0040 | | CR: Si |
| A1CR15 | 1901-0040 | | CR: Si |
| A1CR16 | 1901-0179 | | CR: Si |
| A1CR17 | 1901-0040 | | CR: Si |
| A1CR18 | 1901-0040 | | CR: Si |
| A1CR19 | 1901-0040 | | CR: Si |
| A1CR20 | 1901-0040 | | CR: Si |
| A1CR21 | 1901-0040 | | CR: Si |
| A1CR22 | 1901-0040 | | CR: Si |
| A1CR23 | 1901-0040 | | CR: Si |
| A1CR24 | 1901-0040 | | CR: Si |
| A1CR25 | 1901-0040 | | CR: Si |
| A1CR26 | 1901-0040 | | CR: Si |
| A1CR27 | 1901-0040 | | CR: Si |
| A1CR28 | 1901-0040 | | CR: Si |
| A1CR29 | 1901-0040 | | CR: Si |
| A1CR30 | 1901-0040 | | CR: Si |
| A1CR31 | 1901-0040 | | CR: Si |
| A1CR32 | 1901-0040 | | CR: Si |
| A1CR33 | 1901-0040 | | CR: Si |
| A1CR34 | 1901-0040 | | CR: Si |
| A1CR35 | 1901-0040 | | CR: Si |
| A1CR36 | 1901-0040 | | CR: Si |
| A1CR37 | 1901-0040 | | CR: Si |
| A1J1 | 1251-0213 | 1 | J: Connector, 15 pin |
| A1L1 | 9140-0179 | 7 | L: fxd 22 uH 10% |
| A1L2 | 9140-0179 | | L: fxd 22 uH 10% |
| A1L3 | 9140-0179 | | L: fxd 22 uH 10% |
| A1L4 | 9140-0179 | | L: fxd 22 uH 10% |
| A1L5 | 9140-0179 | | L: fxd 22 uH 10% |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1L6 | 9140-0179 | | L: fxd 22 uH 10% |
| A1L7 | 9140-0179 | | L: fxd 22 uH 10% |
| A1Q1 | 1854-0071 | 3 | Q: Si npn |
| A1Q2 | 1854-0022 | 1 | Q: Si npn |
| A1Q3 | 1854-0296 | 6 | Q: Si npn |
| A1Q4 | 1854-0296 | | Q: Si npn |
| A1Q5 | 1853-0015 | 2 | Q: Si pnp 2N3640 |
| A1Q6 | 1853-0015 | | Q: Si pnp 2N3640 |
| A1Q7 | 1854-0345 | 2 | Q: Si npn 2N5179 |
| A1Q8 | 1854-0345 | | Q: Si npn 2N5179 |
| A1Q9 | 1854-0296 | | Q: Si npn |
| A1Q10 | 1854-0296 | | Q: Si npn |
| A1Q11 | 1855-0062 | 4 | Q: FET, N-channel |
| A1Q12 | 1855-0062 | | Q: FET, N-channel |
| A1Q13 | 1855-0062 | | Q: FET, N-channel |
| A1Q14 | 1854-0221 | 1 | Q: Si npn dual |
| A1Q16 | 1854-0215 | 4 | Q: Si npn 2N3904 |
| A1Q17 | 1854-0215 | | Q: Si npn 2N3904 |
| A1Q18 | 1853-0049 | 5 | Q: Si pnp |
| A1Q19 | 1854-0296 | | Q: Si npn |
| A1Q20 | 1854-0296 | | Q: Si npn |
| A1Q21 | 1854-0298 | 1 | Q: Si npn |
| A1Q22 | 1853-0049 | | Q: Si pnp |
| A1Q23 | 1853-0036 | 2 | Q: Si pnp 2N3906 |
| A1Q24 | 1853-0036 | | Q: Si pnp 2N3906 |
| A1Q25 | 1854-0215 | | Q: Si npn 2N3904 |
| A1Q26 | 1855-0062 | | Q: FET, N-channel |
| A1Q27 | 1854-0215 | | Q: Si npn 2N3904 |
| A1Q28 | 1853-0049 | | Q: Si pnp |
| A1Q29 | 1854-0071 | | Q: Si npn |
| A1Q30 | 1854-0071 | | Q: Si npn |
| A1Q31 | 1853-0049 | | Q: Si pnp |
| A1Q32 | 1853-0049 | | Q: Si pnp |
| A1Q33 | 1853-0050 | 1 | Q: Si pnp |
| A1Q34 | 1853-0045 | 1 | Q: Si pnp 2N4036 |
| A1Q35 | 1854-0358 | 3 | Q: Si npn |
| A1Q36 | 1854-0358 | | Q: Si npn |
| A1Q37 | 1854-0358 | | Q: Si npn |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1R1 | 0757-0394 | 8 | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R2 | 0757-0427 | 3 | R: fxd metflm 1500 ohms 1% 1/8W |
| A1R3 | 0757-0440 | 2 | R: fxd metflm 7500 ohms 1% 1/8W |
| A1R4 | 0757-0290 | 5 | R: fxd metflm 6190 ohms 1% 1/8W |
| A1R5 | 0757-0401 | 14 | R: fxd metflm 100 ohms 1% 1/8W |
| A1R6 | 0757-1000 | 3 | R: fxd metflm 51.1 ohms 1% 1/2W |
| A1R7 | 0757-1000 | | R: fxd metflm 51.1 ohms 1% 1/2W |
| A1R8 | 0757-0274 | 2 | R: fxd metflm 1210 ohms 1% 1/8W |
| A1R9 | 0757-1001 | 2 | R: fxd metflm 56.2 ohms 1% 1/2W |
| A1R10 | 0757-0417 | 2 | R: fxd metflm 562 ohms 1% 1/8W |
| A1R11 | 0757-1001 | | R: fxd metflm 56.2 ohms 1% 1/2W |
| A1R12 | 0757-0427 | | R: fxd metflm 1500 ohms 1% 1/8W |
| A1R13 | 0757-1000 | | R: fxd metflm 51.1 ohms 1% 1/2W |
| A1R14 | 0757-0290 | | R: fxd metflm 6190 ohms 1% 1/8W |
| A1R15 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R16 | 0757-0728 | 1 | R: fxd metflm 619 ohms 1% 1/4W |
| A1R17 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R18 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R19 | 2100-2060 | 1 | R: var cermet lin 50 ohms 20% 1/2W |
| A1R20 | 0757-0815 | 1 | R: fxd metflm 562 ohms 1% 1/2W |
| A1R21 | 0757-0817 | 1 | R: fxd metflm 750 ohms 1% 1/2W |
| A1R22 | 0757-0412 | 3 | R: fxd metflm 365 ohms 1% 1/8W |
| A1R23 | 0757-0412 | | R: fxd metflm 365 ohms 1% 1/8W |
| A1R24 | 0757-0443 | 1 | R: fxd metflm 11 kilohms 1% 1/8W |
| A1R25 | 0757-0391 | 1 | R: fxd metflm 39.2 ohms 1% 1/8W |
| A1R26 | 0757-0736 | 1 | R: fxd metflm 1500 ohms 1% 1/4W |
| A1R27 | 0757-0421 | 2 | R: fxd metflm 825 ohms 1% 1/8W |
| A1R28 | 0698-3429 | 1 | R: fxd metflm 19.6 ohms 1% 1/8W |
| A1R29 | 0757-0818 | 1 | R: fxd metflm 825 ohms 1% 1/2W |
| A1R30 | 0757-0723 | 1 | R: fxd metflm 365 ohms 1% 1/4W |
| A1R31 | 0757-0386 | 2 | R: fxd metflm 24.3 ohms 1% 1/8W |
| A1R32 | 0757-0386 | | R: fxd metflm 24.3 ohms 1% 1/8W |
| A1R33 | 0757-0405 | 2 | R: fxd metflm 162 ohms 1% 1/8W |
| A1R34 | 0757-0273 | 5 | R: fxd metflm 3010 ohms 1% 1/8W |
| A1R35 | 0757-0395 | 1 | R: fxd metflm 56.2 ohms 1% 1/8W |
| A1R36 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R37 | 0757-0408 | 3 | R: fxd metflm 243 ohms 1% 1/8W |
| A1R38 | 0757-0442 | 3 | R: fxd metflm 13.3 kilohms 1% 1/8W |
| A1R39 | 0757-0283 | 4 | R: fxd metflm 2000 ohms 1% 1/8W |
| A1R40 | 0757-0435 | 2 | R: fxd metflm 3920 ohms 1% 1/8W |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1R41 | 0757-0284 | 2 | R: fxd metflm 150 ohms 1% 1/8W |
| A1R42 | 0757-0284 | | R: fxd metflm 150 ohms 1% 1/8W |
| A1R43 | 2100-1761 | 1 | R: var ww log 10 kilohms 10% 1/2W |
| A1R44 | 0757-0290 | | R: fxd metflm 6190 ohms 1% 1/8W |
| A1R45 | 0757-0420 | 1 | R: fxd metflm 750 ohms 1% 1/8W |
| A1R46 | 0757-0430 | 1 | R: fxd metflm 2210 ohms 1% 1/8W |
| A1R47 | 0757-0769 | 1 | R: fxd metflm 51.1 kilohms 1% 1/4W |
| A1R48 | 0757-0408 | | R: fxd metflm 243 ohms 1% 1/8W |
| A1R49 | 0757-0442 | 6 | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R50 | 0757-0481 | 2 | R: fxd metflm 475 kilohms 1% 1/8W |
| A1R51 | 0757-0283 | | R: fxd metflm 2000 ohms 1% 1/8W |
| A1R52 | 0757-0280 | 4 | R: fxd metflm 1000 ohms 1% 1/8W |
| A1R53 | 0698-3154 | 3 | R: fxd metflm 4220 ohms 1% 1/8W |
| A1R54 | 0757-0289 | | R: fxd metflm 13.3 kilohms 1% 1/8W |
| A1R55 | 0757-0416 | 4 | R: fxd metflm 511 ohms 1% 1/8W |
| A1R56 | 0757-0280 | | R: fxd metflm 1000 ohms 1% 1/8W |
| A1R57 | 0757-0317 | 1 | R: fxd metflm 1330 ohms 1% 1/8W |
| A1R58 | 0757-0427 | | R: fxd metflm 1500 ohms 1% 1/8W |
| A1R59 | 0757-0437 | 4 | R: fxd metflm 4750 ohms 1% 1/8W |
| A1R60 | 0698-3154 | | R: fxd metflm 4220 ohms 1% 1/8W |
| A1R61 | 0757-0471 | 1 | R: fxd metflm 182 kilohms 1% 1/8W |
| A1R62 | 0757-0449 | 5 | R: fxd metflm 20 kilohms 1% 1/8W |
| A1R63 | 0757-0481 | | R: fxd metflm 475 kilohms 1% 1/8W |
| A1R64 | 0757-0438 | 2 | R: fxd metflm 5110 ohms 1% 1/8W |
| A1R65 | 0757-0280 | | R: fxd metflm 1000 ohms 1% 1/8W |
| A1R66 | 0757-0449 | | R: fxd metflm 20 kilohms 1% 1/8W |
| A1R67 | 0757-0407 | 1 | R: fxd metflm 200 ohms 1% 1/8W |
| A1R68 | 0764-0012 | 1 | R: fxd metox 6800 ohms 5% 2W |
| A1R69 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R70 | 0757-0416 | | R: fxd metflm 511 ohms 1% 1/8W |
| A1R71 | 0757-0274 | | R: fxd metflm 1210 ohms 1% 1/8W |
| A1R72 | 0698-3439 | 2 | R: fxd metflm 178 ohms 1% 1/8W |
| A1R73 | 0757-0428 | 2 | R: fxd metflm 1620 ohms 1% 1/8W |
| A1R74 | 0757-0416 | | R: fxd metflm 511 ohms 1% 1/8W |
| A1R75 | 0757-0433 | 1 | R: fxd metflm 3320 ohms 1% 1/8W |
| A1R76 | 0757-0465 | 8 | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R77 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R78 | 0757-0411 | 2 | R: fxd metflm 332 ohms 1% 1/8W |
| A1R79 | 0757-0411 | | R: fxd metflm 332 ohms 1% 1/8W |
| A1R80 | 0698-0082 | 1 | R: fxd metflm 464 ohms 1% 1/8W |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1R81 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R82 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R83 | 0698-3439 | | R: fxd metflm 178 ohms 1% 1/8W |
| A1R84 | 0757-0417 | | R: fxd metflm 562 ohms 1% 1/8W |
| A1R85 | 0764-0044 | 1 | R: fxd metox 8200 ohms 5% 2W |
| A1R86 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R87 | 0698-3446 | 3 | R: fxd metflm 383 ohms 1% 1/8W |
| A1R88 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R89 | 0757-0408 | | R: fxd metflm 243 ohms 1% 1/8W |
| A1R90 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R91 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R92 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R93 | 0757-0487 | 2 | R: fxd metflm 825 kilohms 1% 1/8W |
| A1R94 | 0757-0487 | | R: fxd metflm 825 kilohms 1% 1/8W |
| A1R95 | 0757-0418 | 1 | R: fxd metflm 619 ohms 1% 1/8W |
| A1R96 | 0757-0482 | 1 | R: fxd metflm 511 kilohms 1% 1/8W |
| A1R97 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R98 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R99 | 0757-0434 | 1 | R: fxd metflm 3650 ohms 1% 1/8W |
| A1R100 | 0764-0026 | 1 | R: fxd metox 13 kilohms 5% 2W |
| A1R101 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R102 | 0757-0280 | | R: fxd metflm 1000 ohms 1% 1/8W |
| A1R103 | 0757-0449 | | R: fxd metflm 20 kilohms 1% 1/8W |
| A1R104 | 0757-0449 | | R: fxd metflm 20 kilohms 1% 1/8W |
| A1R105 | 0757-0406 | 1 | R: fxd metflm 182 ohms 1% 1/8W |
| A1R106 | 0757-0290 | | R: fxd metflm 6190 ohms 1% 1/8W |
| A1R107 | 0757-0440 | | R: fxd metflm 7500 ohms 1% 1/8W |
| A1R108 | 0757-0283 | | R: fxd metflm 2000 ohms 1% 1/8W |
| A1R109 | 0757-0421 | | R: fxd metflm 825 ohms 1% 1/8W |
| A1R110 | 0698-3446 | | R: fxd metflm 383 ohms 1% 1/8W |
| A1R111 | 0757-0436 | 1 | R: fxd metflm 4320 ohms 1% 1/2W |
| A1R112 | 0757-0464 | 2 | R: fxd metflm 90.9 kilohms 1% 1/8W |
| A1R113 | 0757-0409 | 1 | R: fxd metflm 274 ohms 1% 1/8W |
| A1R114 | 0757-0442 | 1 | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R115 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R116 | 0757-0442 | | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R117 | 0757-0124 | 1 | R: fxd metflm 39.2 kilohms 1% 1/8W |
| A1R118 | 0757-0230 | | R: fxd metflm 1000 ohms 1% 1/8W |
| A1R119 | 0757-0442 | | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R120 | 0757-0410 | 3 | R: fxd metflm 301 ohms 1% 1/8W |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1R121 | 0757-0442 | | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R122 | 0757-0289 | | R: fxd metflm 13.3 kilohms 1% 1/8W |
| A1R123 | 0757-0273 | | R: fxd metflm 3010 ohms 1% 1/8W |
| A1R124 | 0757-0288 | 1 | R: fxd metflm 9090 ohms 1% 1/8W |
| A1R125 | 0757-0465 | | R: fxd metflm 100 kilohms 1% 1/8W |
| A1R126 | 0757-0290 | | R: fxd metflm 6190 ohms 1% 1/8W |
| A1R127 | 0757-0437 | | R: fxd metflm 4750 ohms 1% 1/8W |
| A1R128 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R129 | 0757-0437 | | R: fxd metflm 4750 ohms 1% 1/8W |
| A1R130 | 0757-0451 | 1 | R: fxd metflm 24.3 kilohms 1% 1/8W |
| A1R131 | 0757-0437 | | R: fxd metflm 4750 ohms 1% 1/8W |
| A1R132 | 0757-0469 | 1 | R: fxd metflm 150 kilohms 1% 1/8W |
| A1R133 | 0757-0453 | 1 | R: fxd metflm 30.1 kilohms 1% 1/8W |
| A1R134 | 0757-0472 | 1 | R: fxd metflm 200 kilohms 1% 1/8W |
| A1R135 | 0757-0442 | | R: fxd metflm 10 kilohms 1% 1/8W |
| A1R136 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R137 | 0757-0281 | 1 | R: fxd metflm 2740 ohms 1% 1/8W |
| A1R138 | 0757-0438 | | R: fxd metflm 5110 ohms 1% 1/8W |
| A1R139 | 0757-0410 | | R: fxd metflm 301 ohms 1% 1/8W |
| A1R140 | 0698-3446 | | R: fxd metflm 383 ohms 1% 1/8W |
| A1R141 | 0757-0464 | | R: fxd metflm 90.9 kilohms 1% 1/8W |
| A1R142 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R143 | 0757-0273 | | R: fxd metflm 3010 ohms 1% 1/8W |
| A1R144 | 0757-0416 | | R: fxd metflm 511 ohms 1% 1/8W |
| A1R145 | 0757-1094 | 1 | R: fxd metflm 1470 ohms 1% 1/8W |
| A1R146 | 0757-0454 | | R: fxd metflm 33.2 kilohms 1% 1/8W |
| A1R147 | 0757-0283 | | R: fxd metflm 2000 ohms 1% 1/8W |
| A1R148 | 0698-3154 | | R: fxd metflm 4220 ohms 1% 1/8W |
| A1R149 | 0684-0271 | 1 | R: fxd metflm 2.7 ohms 10% 1/4W |
| A1R150 | 2100-1776 | 3 | R: var ww log 10 kilohms 10% 1/2W |
| A1R151 | 2100-1776 | | R: var ww log 10 kilohms 10% 1/2W |
| A1R152 | 2100-1776 | | R: var ww log 10 kilohms 10% 1/2W |
| A1R153 | 0687-4721 | 1 | R: fxd comp 4700 ohms 10% 1/2W |
| A1R154 | 0757-0405 | | R: fxd metflm 162 ohms 1% 1/8W |
| A1R155 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R156 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R157 | 0757-0449 | | R: fxd metflm 20 kilohms 1% 1/8W |
| A1R158 | 0757-0273 | | R: fxd metflm 3010 ohms 1% 1/8W |
| A1R159 | 0757-0273 | | R: fxd metflm 3010 ohms 1% 1/8W |
| A1R160 | 0757-0412 | | R: fxd metflm 365 ohms 1% 1/8W |

Table 6-2. Replaceable Parts (Cont'd)

| Ref Desig | HP Part No. | TQ | Description (Refer to Table 6-1.) |
|---|---|---|---|
| A1R161 | 0757-0428 | | R: fxd metflm 1620 ohms 1% 1/8W |
| A1R163 | 0757-0435 | | R: fxd metflm 3920 ohms 1% 1/8W |
| A1R164 | 0757-0394 | | R: fxd metflm 51.1 ohms 1% 1/8W |
| A1R165 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R166 | 0757-0388 | 1 | R: fxd metflm 30.1 ohms 1% 1/8W |
| A1R167 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R168 | 0757-0477 | | R: fxd metflm 332 kilohms 1% 1/8W |
| A1R169 | 0757-0401 | | R: fxd metflm 100 ohms 1% 1/8W |
| A1R170 | 0757-0410 | | R: fxd metflm 301 ohms 1% 1/8W |
| A1U1 | 5060-0487 | 2 | U: Transistor array |
| A1U2 | 5060-0487 | | U: Transistor array |
| A1U3 | 1821-0002 | 2 | U: Transistor array RCA CA3045 |
| A1U4 | 1821-0002 | | U: Transistor array RCA CA3045 |
| A1VR1 | 1902-0519 | 3 | VR: avalanche 5.11V 2% |
| A1VR2 | 1902-3234 | 2 | VR: avalanche 19.6V 5% |
| A1VR3 | 1902-3234 | | VR: avalanche 19.6V 5% |
| A1VR4 | 1902-3139 | 1 | VR: avalanche 8.25V 5% |
| A1VR5 | 1902-3182 | 1 | VR: avalanche 12.1V 5% |
| A1VR6 | 1902-3104 | 1 | VR: avalanche 5.62V 5% |
| A1VR7 | 1902-0519 | | VR: avalanche 5.11V 2% |
| A1VR8 | 1902-0519 | | VR: avalanche 5.11V 2% |
| | | | **A2** |
| A2 | 01840-66502 | 1 | A: Switch board assy |
| A2C1 | 0140-0207 | 1 | C: fxd mica 330 pF 5% 500 wVdc |
| A2C2 | 0160-0155 | 1 | C: fxd mylar 3300 pF 10% 200 wVdc |
| A2C3 | 0160-0163 | 1 | C: fxd mylar 0.033 uF 10% 200 wVdc |
| A2C4 | 0180-0195 | 1 | C: fxd Ta 0.33 uF 20% 35 wVdc |
| A2C5 | 0180-0161 | 1 | C: fxd Ta 3.3 uF 20% 35 wVdc |
| A2C6 | 0180-2111 | 1 | C: fxd Ta 33 uF 10% 35 wVdc |
| A2C7 | 0160-2216 | 1 | C: fxd mica 820 pF 5% 300 wVdc |
| A1C8 | 0160-2432 | 1 | C: fxd poly 0.1 uF 5% 100 wVdc |
| A2R1 | 0698-7527 | 3 | R: fxd metflm 15 kilohms 0.1% 1/2W |
| A2R2 | 0698-7527 | | R: fxd metflm 15 kilohms 0.1% 1/2W |
| A2R3 | 0698-7530 | 2 | R: fxd metflm 37.5 kilohms 0.1% 1/4W |
| A2R4 | 0698-7530 | | R: fxd metflm 37.5 kilohms 0.1% 1/4W |
| A2R5 | 0698-7527 | | R: fxd metflm 15 kilohms 0.1% 1/2W |
| A2R6 | 0698-7529 | 1 | R: fxd metflm 150 kilohms 0.1% 1/8W |
| A2R7 | 0698-7528 | 2 | R: fxd metflm 375 kilohms 0.1% 1/8W |
| A2R8 | 0698-7528 | | R: fxd metflm 375 kilohms 0.1% 1/8W |

# SECTION VII

# MANUAL CHANGES AND OPTIONS

## 7-1. MANUAL CHANGES.

7-2. This manual applies directly to the Model 1840A Time Bases having a serial prefix as shown on the title page of this manual. The following paragraphs explain how to adapt this manual to newer instruments (higher serial prefix) or older instruments (lower prefix). Technical corrections to this manual (if any) are called Errata and are listed on a separate Manual Changes sheet supplied with this manual.

7-3. NEWER INSTRUMENTS. If the serial prefix of your Model 1840A is above the serial prefix shown on the title page, refer to a separate Manual Changes sheet supplied with this manual. Locate the serial prefix of the instrument and make the indicated changes.

7-4. OLDER INSTRUMENTS. If the serial prefix of your Model 1840A is below the serial prefix shown on the title page, refer to Table 7-1 for the changes necessary to adapt this manual to your particular instrument. Locate the serial prefix of the instrument in the table and make the indicated changes.

## 7-5. OPTIONS.

7-6. Options are standard modifications performed on HP instruments at the factory. No options are offered for the Model 1840A at this time.

## 7-7. SPECIAL INSTRUMENTS.

7-8. Special instruments are standard HP instruments that are modified at the factory according to customer specificatons. These instruments are identified by a tag adjacent to the serial number tag. A separate insert sheet is included in the manual for each special instrument which has been modified electrically or in any other manner that would affect the replaceable parts lists. Change the manual according to the insert sheet for proper instrument coverage. If the insert sheet is missing, contact the local Hewlett-Packard Sales/Service Office. Be sure to give complete description of the instrument, including the eight-digit serial number and specification number.

Table 7-1. Manual Changes

| Serial Prefix | Make Changes |
|---|---|
| No backdating changes are required at this time. | |

# SECTION VIII

# SCHEMATICS AND TROUBLESHOOTING

## 8-1. INTRODUCTION.

8-2. This section combines detailed information, including repair and replacement, component identification, schematic information, and troubleshooting, all integrated with the appropriate schematic. Other information and procedures related to performance check and adjustment procedures are located in Section V.

## 8-3. SCHEMATIC INFORMATION.

8-4. All schematics for Model 1840A are contained in this section. (Refer to the List of Illustrations to locate a circuit by description.) They are drawn to show the electronic function of the circuitry, and a given schematic may include all or part of several different physical assemblies. Table 8-1 identifies the symbols and conventions used. The schematics also indicate waveform test points and typical dc voltages; refer to troubleshooting paragraphs for details of interpreting waveforms and dc voltages. Note that all schematics are printed so the entire schematic unfolds outside the right-hand edge of the manual.

## 8-5. COMPONENT LOCATION.

8-6. Whenever possible, the location of components appearing on a schematic is shown on the page opposite that schematic. When components on an assembly appear on more than one schematic, the location of all components on that assembly are identified opposite the first schematic showing that assembly. Adjustments are identified in the adjustment location figure in Section V.

## 8-7. COMPONENT IDENTIFICATION.

8-8. All components within the assembly border lines of the schematics are physically located on an etched circuit board or within a switch assembly. There are two assemblies listed in the replaceable parts list of this manual. To distinguish between the different assemblies, each is designated on the schematic with the letter followed by a number (either 1 or 2). Component designation begins with the number 1 for each type of component on each assembly and ascends in sequence (e.g. R1, R2, . . C1, C2,). Since component designation follows the same sequence on each assembly, designators are duplicated on different assemblies. Therefore, for distinction, the component description of resistor R1 on assembly A1 is A1R1, and resistor R1 on assembly A2 is A2R1. Components not physically located on an assembly are shown outside the assembly borders of the schematics and have only the basic component designator, such as R1 or C1. These parts are listed ahead of the assembly break-down section of the parts list. A reference designation box on each schematic indicates all components appearing on that schematic.

## 8-9. REPAIR AND REPLACEMENT.

8-10. The following paragraphs provide procedures for removing and replacing components from etched circuit boards. Section VI provides a detailed parts list for ordering replacement parts. If satisfactory repair or replacement cannot be accomplished, contact the nearest HP Sales/Service Office (addresses at rear of this manual) for assistance. If shipment for repair is recommended, see Section II of this manual for repackaging and shipping information.

### 8-11. SERVICING ETCHED CIRCUIT BOARDS.

8-12. Etched circuit boards used in the Model 1840A have components mounted on both sides, conductive surfaces on both sides, and plated-through component mounting holes. Components may therefore be removed by heating the joint from either side of the board. Hewlett-Packard Service Note M-20E contains useful information on servicing and repair of printed circuit boards. Some important tips are as follows:

a. Use a 37- to 47.5-watt chisel tip soldering iron with a tip diameter of 1/16 to 1/8 inch, and small-diameter rosin-core solder.

b. Components may be removed by heating component connections with a soldering iron on either side of the board. If heat is applied to the component side of the board, greater care is required to avoid damaging adjacent components. Extreme care is required to avoid damage to semiconductor devices. Heat damage may be minimized by using long nose pliers as a heat sink between component lead and soldering iron.

c. If a component is obviously damaged or faulty, clip the leads close to the component, and unsolder the leads from the board.

d. Large components, such as potentiometer, may be removed by rotating the iron from one lead to another while gently applying pressure to lift the component from the board.

e. Excessive heat or force will destroy the laminate bond between the metal plated surface and the board. If this should occur, the lifted conductor may be cemented down with a small amount of quick-drying acetate-base cement having good insulating properties. A section of good conducting wire may be soldered along the damaged area if the cement is not available.

f. Before replacing a component, heat the remaining solder in the component hole and clean it out with a toothpick or similar object. Sharp pointed metallic tools are not recommended because they may damage the plated-through surface of the hole.

g. Tin and shape leads of replacement component to fix existing holes.

h. Install components in the same position as the original component.

i. When removing or replacing square-pin connections, be sure to pull straight up for removal and replacement. These connections can be damaged and cause poor contact.

### 8-13. INTEGRATED CIRCUIT REPLACEMENT.

8-14. The Integrated Circuit (IC) packages are relatively expensive. Unless the unit to be removed has been definitely determined to have failed, great care should be taken to prevent damage during removal. Soldering irons which can simultaneously heat all soldered connections are available from various manufacturers. These types of soldering irons permits rapid removal of the IC package in one operation. Also available are soldering irons with a built-in "solder sucker" which facilitates quick removal. The following procedure is recommended if a standard soldering iron is used for IC removal:

a. Use a soldering iron having a small pencil tip (e.g. Weller No. PT-H7), and carefully heat an IC lead solder joint. When the solder is fluid, quickly remove the solder with a solder sucker. Repeat until all IC leads have been freed.

b. Check each lead by carefully moving it with long nose pliers to be sure that it is mechanically free from the circuit board.

c. When all leads are loose, carefully remove the IC package. The dual in-line type package may be removed by gently gripping the top and bottom with long nose pliers and carefully rolling the package out.

d. Using a toothpick or solder sucker carefully remove all remaining solder from the plated through holes.

e. Insert the replacement IC package into the circuit board, and connect it by using the previously recommended soldering procedures.

Note

Be extremely careful not to over heat the IC package with the soldering iron.

8-15. In replacing an integrated circuit package, take careful note of the mark or notch which is provided for package orientation. The component identification photos and the integrated circuit pin location diagrams of this manual show the IC orientation.

## 8-16. TROUBLESHOOTING.

### 8-17. GENERAL.

8-18. Troubleshooting information in this manual applies directly to Model 1840A. Refer to appropriate manual for information on other instruments. The most important prerequisite to systematic troubleshooting is understanding instrument circuitry operation. Refer to Section IV for block diagram and principles of operation. To isolate trouble to either oscilloscope mainframe, horizontal plug-in or the vertical plug-in, use basic operating procedures given in Section III to isolate trouble to a circuit associated with a front-panel control. Also check for the proper outputs from the low and high voltage power supplies since these voltages affect the CRT display and proper operation of the plug-ins.

### 8-19. VISUAL INSPECTION.

8-20. Make a thorough visual inspection of the instrument(s) prior to using waveforms and dc voltages for troubleshooting. Check for burned or loose components, loose wire connections, faulty switch contacts, or any similar condition suggesting a source of trouble. If faulty operation is still present, proceed to the electrical checkout.

### 8-21. ELECTRICAL CHECKOUT.

8-22. Typical waveforms are located near the applicable schematic. Always use specified conditions given in Table 8-2 for making waveform measurements. Check waveforms in a signal flow sequence; an incorrect waveform (or none) indicates the circuit likely to be at fault. Test points on schematics are shown at an electrical point which are readily excessible at the physical/electrical corresponding point on the etched circuit board. Check typical dc voltages (given on the schematic) in the suspect circuit to further isolate trouble to a specific component. Conditions for dc voltages are given in Table 8-2. Always allow time for a stable dc voltage level to be reached before noting value. In locating test points on board assemblies, note that a small dot etched on the printed circuit board identifies the emitter lead of transistors, the source lead of FET's, the cathode lead of diodes, the pin-1 lead of integrated circuits (Figure 8-1), and the positive side of electrolytic capacitors.

CAUTION

When taking waveform or dc measurements, use extreme care to ensure that no supply voltages or components are shorted.

8-23. The N-channel type field-effect transistors (FET) are designed with current flow from source to drain. However, current can flow in the opposite direction in most FET's and maintain proper operation. The FET's used in the Model 1840A do operate with current flow from drain to source but the FET's schematic representation complies with manufacturers original designations.

## 8-24. TROUBLESHOOTING AIDS.

8-25. The following information should prove helpful in troubleshooting the HP Model 1840A. Typical operating conditions and explanations to be aware of are discussed.

### 8-26. 10.2-VOLT SUPPLY.

8-27. The dual tunnel diode trigger circuit and associated circuitry uses a +10.2-volt supply from the +15-volt supply. Tolerances of voltage regulator diodes A1VR7 and VR8 might vary the +10.2-volt supply as much as ±250 mV without affecting circuit operation. For example, the base of auto trigger amplifier transistor A1U3Q2 uses the +10.2-volt supply. The gate signal at base of transistor A1U3Q1 also uses the +10.2-volt supply. If the +10.2-volt supply is not exactly +10.2 volts, the potential between the bases of A1U3Q1 and Q2 is still correct and proper operation is maintained.

### 8-28. GATE VOLTAGE LEVELS.

8-29. The voltage at the base of transistor A1U4Q1 is dependent upon the gate being turned on or turned off. If the gate is off, the voltage at the base of transistor A1U4Q1 will be approximately +10.5 volts and the first set of voltages should be used when troubleshooting. If the voltage level at base of A1U4Q1 is approximately +10.1 volts, the gate is on and the second set of voltages should be used when troubleshooting. The second condition should not exist, that is,gate on. A likely cause for the gate being on is that the control reset is not removing arming current from the dual tunnel diode trigger circuit and turning off the gate. Another possible cause is that the length Schmitt circuit might not change states and cause the control reset to change states. This is required to remove arming current from the dual tunnel diode trigger circuit. However, the sweep may return to approximately 7 volts at the emitter of transistor A1Q17 if the hold-off driver is operating properly. The hold-off driver circuit will turn on the fast reset transistor, A1Q20, and discharge the integrator capacitor to approximately 7 volts.

### 8-30. SWEEP TERMINATION.

8-31. When the sweep ramp reaches +10 volts, the length Schmitt and control reset should switch states and end the gate. The voltage level at the emitter of transistor A1Q17 should also return to 0 volt. If the voltage level at emitter of transistor A1Q17 settles at approximately +18 volts, the hold-off driver might not be operating properly. That is, the hold-off driver will not permit the gate to end and also will not permit transistor A1Q20 to turn on and discharge the integrator capacitor. Thus, the sweep integrator capacitor might charge to approximately +18 volts as measured at the base of transistor A1Q13 or the emitter of transistor A1Q17.

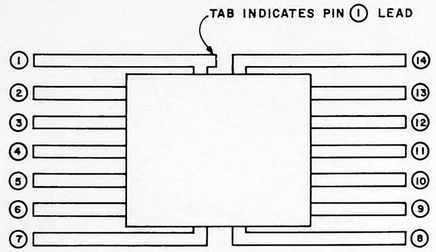
### 8-32. SWEEP RAMP.

8-33. When the sweep gate is turned on, the sweep integrator should charge to +10 volts. The +10-volt waveform can be sampled either at the gate of FET A1Q13 or the emitter of transistor A1Q17. If the waveforms at both points in the circuit are not the same amplitude, the sweep reader may be at fault. If the +10-volt waveform is not linear, the sweep current source, transistors A1Q33 through A1Q37, may be the source of trouble.

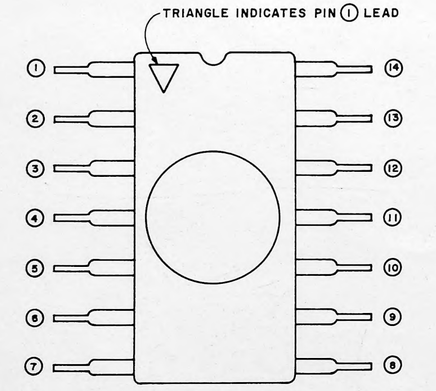
## 8-34. DISASSEMBLY INFORMATION.

8-35. When repairing or replacing main printed circuit board A1, it may be helpful to remove right chassis assembly MP9. Removal of MP9 requires removing 16 screws.

8-36. The SWEEP TIME/DIV switch can also be repaired or replaced easily. To remove the switch from the instrument, set SWEEP TIME/DIV switch to 10 millisecond. Then lean the board toward back of the instrument while pulling printed circuit board from the socket. To disassemble the switch, remove retainer ring MP21; then the two rotor sections, MP22 and MP23, can be separated from printed circuit board. If the contact areas of the printed circuit board or the two rotors show excessive wear, replace the respective parts. For cleaning, spray with a degreaser comparable to MS-180 FREON TF DEGREASER produced by Miller-Stephenson Chemical Company, Inc., and lightly lubricate the contact areas of the printed boards and rotor sections. Lubricate contact areas with a lubricant comparable to LUBRIPLATE produced by FISKE BROTHERS REFINING COMPANY. The LUBRIPLATE is available from Hewlett-Packard Co.; order HP Part No. 6040-0018. Refer to Figure 6-1 for correct reinstallation position of the rotors.




DETAILED TOP VIEW OF
AIU1 AND U2




DETAILED TOP VIEW OF
AIU3 AND U4

1840A-B-3

Figure 8-1. Integrated Circuit Pin Locations

Table 8-1. Symbols and Conventions

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front panel marking

= Rear panel marking

= Front panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

N C = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single pin connector on board

= Pin of a plug-in board (with letter or number)

= Main signal path

= Primary feedback path

= Secondary feedback path

* = Optimum value selected at factory, average value shown; part may have been omitted.

= Field effect transistor (N-channel)

= Breakdown diode

= Tunnel diode

= Step recovery diode

= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

Wire colors are given by numbers in parentheses using the resistor color code [ (925) is wht-red-grn ].

| | |
|---|---|
| 0 - Black | 5 - Green |
| 1 - Brown | 6 - Blue |
| 2 - Red | 7 - Violet |
| 3 - Orange | 8 - Gray |
| 4 - Yellow | 9 - White |

Switch wafers are identified as follows:

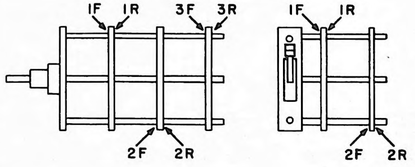



Table 8-2. DC Voltages and Waveform Measurement Conditions

## DC VOLTAGE MEASUREMENT CONDITIONS

1. CONTROL SETTINGS:

| | |
|---|---|
| SWEEP HOLD OFF | NORM |
| SWEEP VERNIER | CAL |
| TRIGGER LEVEL | 0 (zero) |
| EXT/INT | INT |
| AC/DC | DC |
| LINE | pushbutton out |
| ÷10/÷1 | ÷1 |
| NEG/POS | POS |
| NORM/AUTO | AUTO |
| SINGLE | pushbutton in |
| SWEEP TIME/DIV | 0.1 msec |

2. Measure voltage at collec
is approximately +14 v
parenthesis. If voltage is
use voltages in parenthesis

3. Voltages are referenced
Measurements may vary s
instrument.

4. These dc voltages conditi

## WAVEFORM MEASUREMENT CONDITIONS

1. CONTROL SETTINGS:

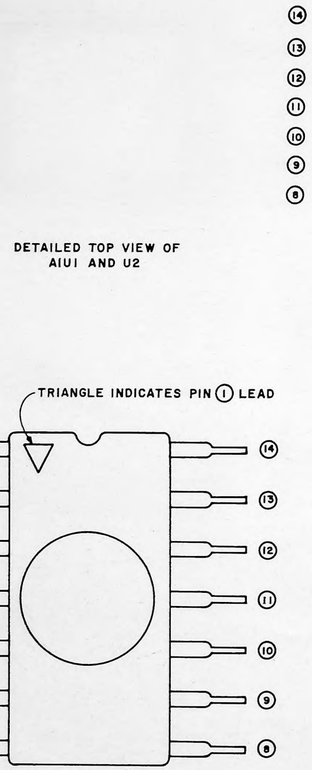
| | |
|---|---|
| SWEEP HOLD OFF | NORM |
| SWEEP VERNIER | CAL |
| EXT/INT | EXT |
| AC/DC | DC |
| LINE | pushbutton out |
| ÷10/÷1 | ÷1 |
| NEG/POS | POS |
| NORM/AUTO | NORM |
| SINGLE | pushbutton out |
| SWEEP TIME/DIV | 0.5 usec |

2. Connect 100-kHz, 1V pk-pk sine wave to EXT INPUT.

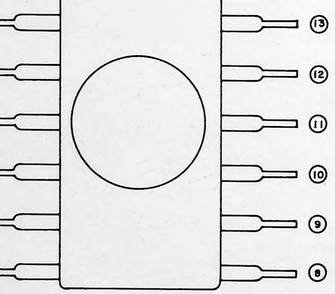
3. Adjust TRIGGER LEVE
TP2 and TP3.

4. All waveforms are refer
Note: A 10:1 divider
waveforms.

5. These waveform conditio
The waveforms for the g
in Figure 8-3. The wave
schematic are in Figure 8-




DETAILED TOP VIEW OF
AIU1 AND U2




DETAILED TOP VIEW OF
AIU3 AND U4

1840A-8-3

ure 8-1. Integrated Circuit Pin Locations

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front panel marking

= Rear panel marking

= Front panel control

= Screwdriver adjustment

P/O = Part of

CW = Clockwise end of variable resistor

N C = No connection

= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

= Single pin connector on board

= Pin of a plug-in board (with letter or number)

= Main signal path

= Primary feedback path

= Secondary feedback path

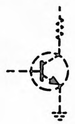
* = Optimum value selected at factory, average value shown; part may have been omitted.

= Field effect transistor (N-channel)

= Breakdown diode

= Tunnel diode

= Step recovery diode



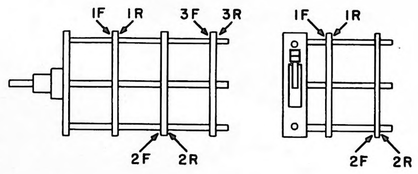
= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

Wire colors are given by numbers in parentheses using the resistor color code [ (925) is wht-red-grn ].

| | |
|---|---|
| 0 - Black | 5 - Green |
| 1 - Brown | 6 - Blue |
| 2 - Red | 7 - Violet |
| 3 - Orange | 8 - Gray |
| 4 - Yellow | 9 - White |

Switch wafers are identified as follows:






## DC VOLTAGE MEASUREMENT CONDITIONS

1. CONTROL SETTINGS:

| | |
|---|---|
| SWEEP HOLD OFF | NORM |
| SWEEP VERNIER | CAL |
| TRIGGER LEVEL | 0 (zero) |
| EXT/INT | INT |
| AC/DC | DC |
| LINE | pushbutton out |
| ÷10/÷1 | ÷1 |
| NEG/POS | POS |
| NORM/AUTO | AUTO |
| SINGLE | pushbutton in |
| SWEEP TIME/DIV | 0.1 msec |

2. Measure voltage at collector of A1U4Q1. If voltage is approximately +14 volts, use voltages not in parenthesis. If voltage is approximately +15 volts, use voltages in parenthesis for troubleshooting.

3. Voltages are referenced to chassis ground. Note: Measurements may vary slightly from instrument to instrument.

4. These dc voltages conditions apply to all schematics.

## WAVEFORM MEASUREMENT CONDITIONS

1. CONTROL SETTINGS:

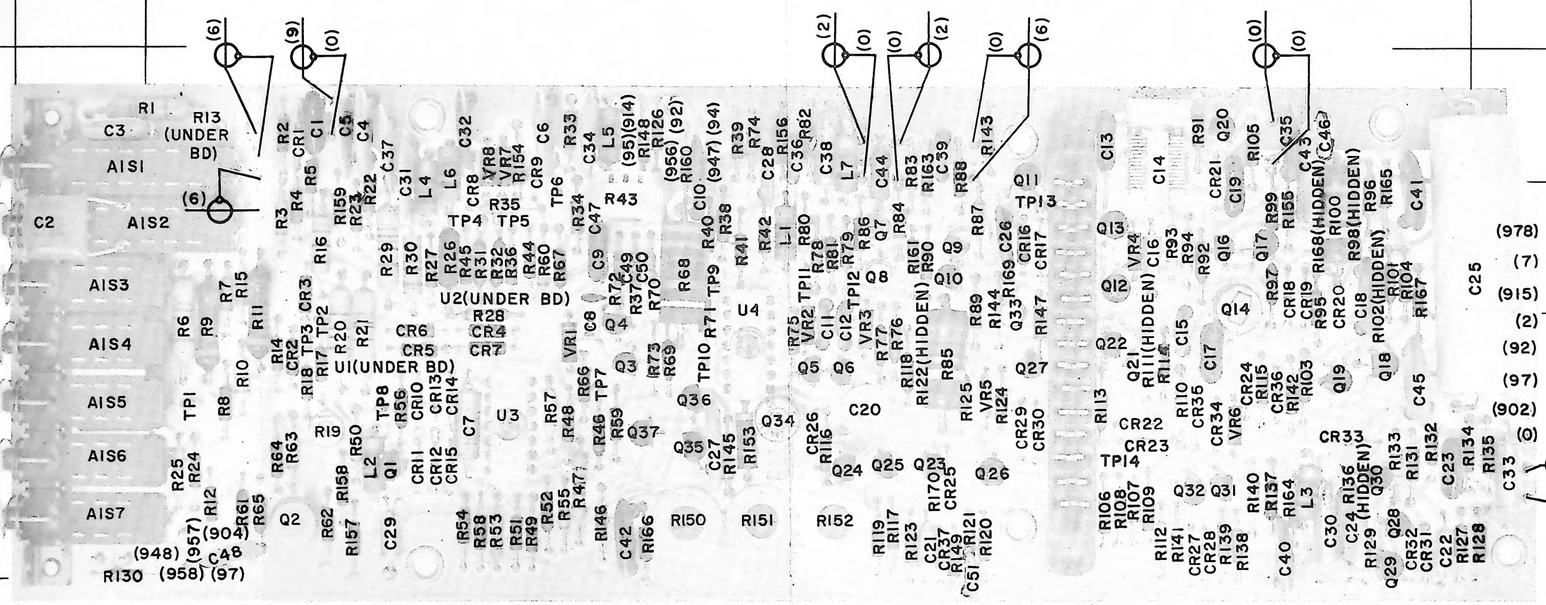
| | |
|---|---|
| SWEEP HOLD OFF | NORM |
| SWEEP VERNIER | CAL |
| EXT/INT | EXT |
| AC/DC | DC |
| LINE | pushbutton out |
| ÷10/÷1 | ÷1 |
| NEG/POS | POS |
| NORM/AUTO | NORM |
| SINGLE | pushbutton out |
| SWEEP TIME/DIV | 0.5 usec |

2. Connect 100-kHz, 1V pk-pk sine wave to EXT INPUT.

3. Adjust TRIGGER LEVEL to obtain equal voltage at TP2 and TP3.

4. All waveforms are referenced to chassis ground. Note: A 10:1 divider probe was used for all waveforms.

5. These waveform conditions apply to all schematics. The waveforms for the gate generator schematic are in Figure 8-3. The waveforms for sweep generator schematic are in Figure 8-6.



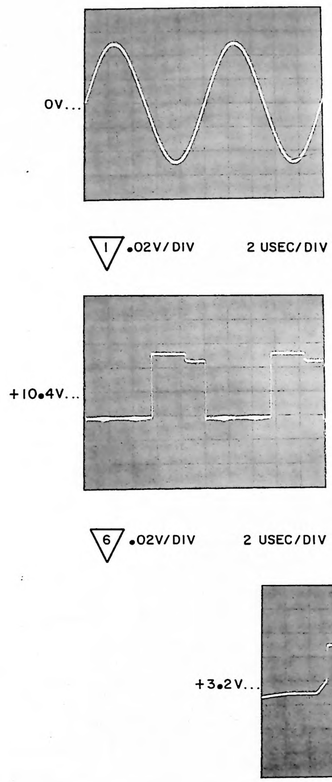

Note: Printed circuit boards have plated through component holes. This permits soldering from either side of the board.

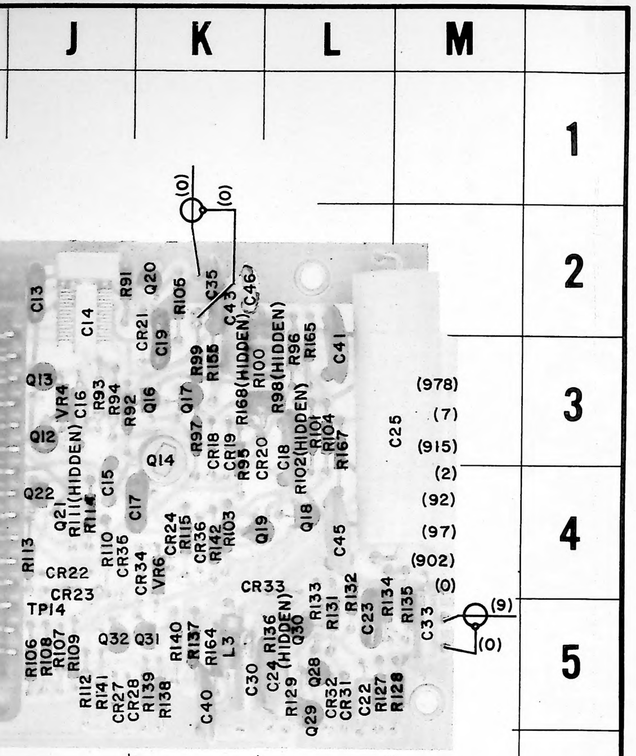
| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1S1 | B-2 | C12 | H-5 | C30 | K-5 | C48 | C-5 | CR15 | E-5 | CR33 | L-4 | Q7 | H-3 | Q26 | I-5 |
| A1S2 | C-3 | C13 | J-2 | C31 | D-3 | C49 | F-3 | CR16 | I-3 | CR34 | K-4 | Q8 | H-3 | Q27 | I-4 |
| A1S3 | B-3 | C14 | J-2 | C32 | E-2 | C50 | F-3 | CR17 | I-3 | CR35 | J-4 | Q9 | I-3 | Q28 | L-5 |
| A1S4 | B-4 | C15 | J-4 | C33 | M-5 | C51 | I-5 | CR18 | K-3 | CR36 | K-4 | Q10 | I-3 | Q29 | L-5 |
| A1S5 | B-4 | C16 | J-3 | C34 | F-2 | CR1 | D-2 | CR19 | K-3 | CR37 | I-5 | Q11 | I-3 | Q30 | L-5 |
| A1S6 | B-5 | C17 | K-4 | C35 | K-2 | CR2 | D-4 | CR20 | L-3 | LT | G-3 | Q12 | J-3 | Q31 | K-5 |
| A1S7 | B-5 | C18 | L-3 | C36 | G-2 | CR3 | D-3 | CR21 | K-2 | L2 | D-5 | Q13 | J-3 | Q32 | J-5 |
| C1 | D-2 | C19 | K-2 | C37 | D-2 | CR4 | E-4 | CR22 | J-4 | L3 | K-5 | Q14 | K-3 | Q33 | I-4 |
| C2 | B-3 | C20 | H-4 | C38 | H-2 | CR5 | E-4 | CR23 | J-5 | L4 | E-3 | Q16 | K-3 | Q34 | G-4 |
| C3 | B-2 | C21 | H-5 | C39 | I-2 | CR6 | E-4 | CR24 | K-4 | L5 | F-2 | Q17 | K-3 | Q35 | G-5 |
| C4 | D-2 | C22 | L-5 | C40 | K-5 | CR7 | E-4 | CR25 | I-5 | L6 | E-3 | Q18 | L-4 | Q36 | G-4 |
| C5 | D-2 | C23 | L-5 | C41 | L-3 | CR8 | E-3 | CR26 | H-4 | L7 | H-2 | Q19 | L-4 | Q37 | F-4 |
| C6 | F-2 | C24 | L-5 | C42 | F-5 | CR9 | E-2 | CR27 | J-5 | Q1 | D-5 | Q20 | R-2 | R1 | B-2 |
| C7 | E-4 | C25 | M-3 | C43 | K-2 | CR10 | E-4 | CR28 | K-5 | Q2 | D-5 | Q21 | J-4 | R2 | D-2 |
| C8 | F-4 | C26 | I-3 | C44 | H-2 | CR11 | E-5 | CR29 | I-4 | Q3 | F-4 | Q22 | J-4 | R3 | D-3 |
| C9 | F-3 | C27 | G-5 | C45 | L-4 | CR12 | E-4 | CR30 | I-4 | Q4 | F-4 | Q23 | H-5 | R4 | D-3 |
| C10 | G-3 | C28 | G-2 | C46 | K-2 | CR13 | E-4 | CR31 | L-5 | Q5 | H-4 | Q24 | H-5 | R5 | D-2 |
| C11 | H-5 | C29 | D-5 | C47 | F-3 | CR14 | E-4 | CR32 | L-5 | Q6 | H-4 | Q25 | H-5 | R6 | C-4 |

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R7 | C-3 | R25 | C-5 | R44 | E-3 | R63 | D-5 | R82 | G-2 | R101 | L-3 | R120 | I-5 | R139 | K-5 |
| R8 | C-4 | R26 | E-3 | R45 | E-3 | R64 | D-5 | R83 | H-2 | R102 | L-4 | R121 | I-5 | R140 | K-5 |
| R9 | C-4 | R27 | E-3 | R46 | F-4 | R65 | C-5 | R84 | H-3 | R103 | K-4 | R122 | H-4 | R141 | J-5 |
| R10 | C-4 | R28 | E-4 | R47 | F-5 | R66 | F-4 | R85 | I-4 | R104 | L-3 | R123 | H-5 | R142 | K-4 |
| R11 | C-4 | R29 | D-3 | R48 | F-4 | R67 | F-3 | R86 | H-3 | R105 | K-2 | R124 | I-4 | R143 | I-2 |
| R12 | C-5 | R30 | E-3 | R49 | E-5 | R68 | G-3 | R87 | I-3 | R106 | J-5 | R125 | I-4 | R144 | I-3 |
| R13 | C-2 | R31 | E-3 | R50 | D-5 | R69 | F-4 | R88 | I-3 | R107 | J-5 | R126 | F-2 | R145 | G-4 |
| R14 | D-4 | R32 | E-3 | R51 | E-5 | R70 | F-3 | R89 | I-3 | R108 | J-5 | R127 | I-5 | R146 | F-5 |
| R15 | C-3 | R33 | F-2 | R52 | F-5 | R71 | F-3 | R90 | H-3 | R109 | J-5 | R128 | M-5 | R147 | I-4 |
| R16 | D-3 | R34 | E-3 | R53 | E-5 | R72 | F-3 | R91 | J-2 | R110 | J-4 | R129 | L-5 | R148 | F-2 |
| R17 | D-4 | R35 | E-3 | R54 | E-5 | R73 | F-4 | R92 | J-3 | R111 | J-4 | R130 | B-6 | R149 | I-5 |
| R18 | D-4 | R36 | E-3 | R55 | F-5 | R74 | G-2 | R93 | J-3 | R112 | J-5 | R131 | L-5 | R150 | G-5 |
| R19 | D-4 | R37 | F-3 | R56 | D-4 | R75 | G-4 | R94 | J-3 | R113 | J-4 | R132 | L-5 | R151 | G-5 |
| R20 | D-4 | R38 | G-3 | R57 | F-4 | R76 | H-4 | R95 | K-4 | R114 | J-4 | R133 | L-5 | R152 | H-5 |
| R21 | D-4 | R39 | G-2 | R58 | E-5 | R77 | H-4 | R96 | L-3 | R115 | K-4 | R134 | L-5 | R153 | G-5 |
| R22 | D-5 | R40 | G-3 | R59 | F-4 | R78 | H-3 | R97 | K-2 | R116 | H-5 | R135 | M-5 | R154 | F-2 |
| R23 | D-5 | R41 | G-3 | R60 | F-3 | R79 | H-3 | R98 | L-3 | R117 | H-5 | R136 | L-5 | R155 | K-1 |
| R24 | C-5 | R42 | G-3 | R61 | C-5 | R80 | G-3 | R99 | K-2 | R118 | H-4 | R137 | K-5 | R156 | G-2 |
| | | R43 | F-3 | R62 | D-5 | R81 | H-3 | R100 | K-2 | R119 | H-5 | R138 | K-5 | R157 | D-5 |

| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| R158 | D-5 | TP8 | D-4 |
| R159 | D-3 | TP9 | G-3 |
| R160 | G-2 | TP10 | G-4 |
| R161 | H-3 | TP11 | A-3 |
| R163 | H-2 | TP12 | A-3 |
| R164 | K-5 | TP13 | I-3 |
| R165 | L-3 | TP14 | J-5 |
| R166 | F-5 | U1 | E-4 |
| R167 | L-3 | U2 | E-3 |
| R168 | K-2 | U3 | E-4 |
| R169 | I-3 | U4 | G-3 |
| R170 | H-5 | VR1 | F-4 |
| TP1 | C-4 | VR2 | H-4 |
| TP2 | D-4 | VR3 | H-4 |
| TP3 | D-4 | VR4 | J-3 |
| TP4 | E-3 | VR5 | I-4 |
| TP5 | E-3 | VR6 | K-4 |
| TP6 | F-3 | VR7 | E-2 |
| TP7 | F-4 | VR8 | E-2 |

1840A-B-IA



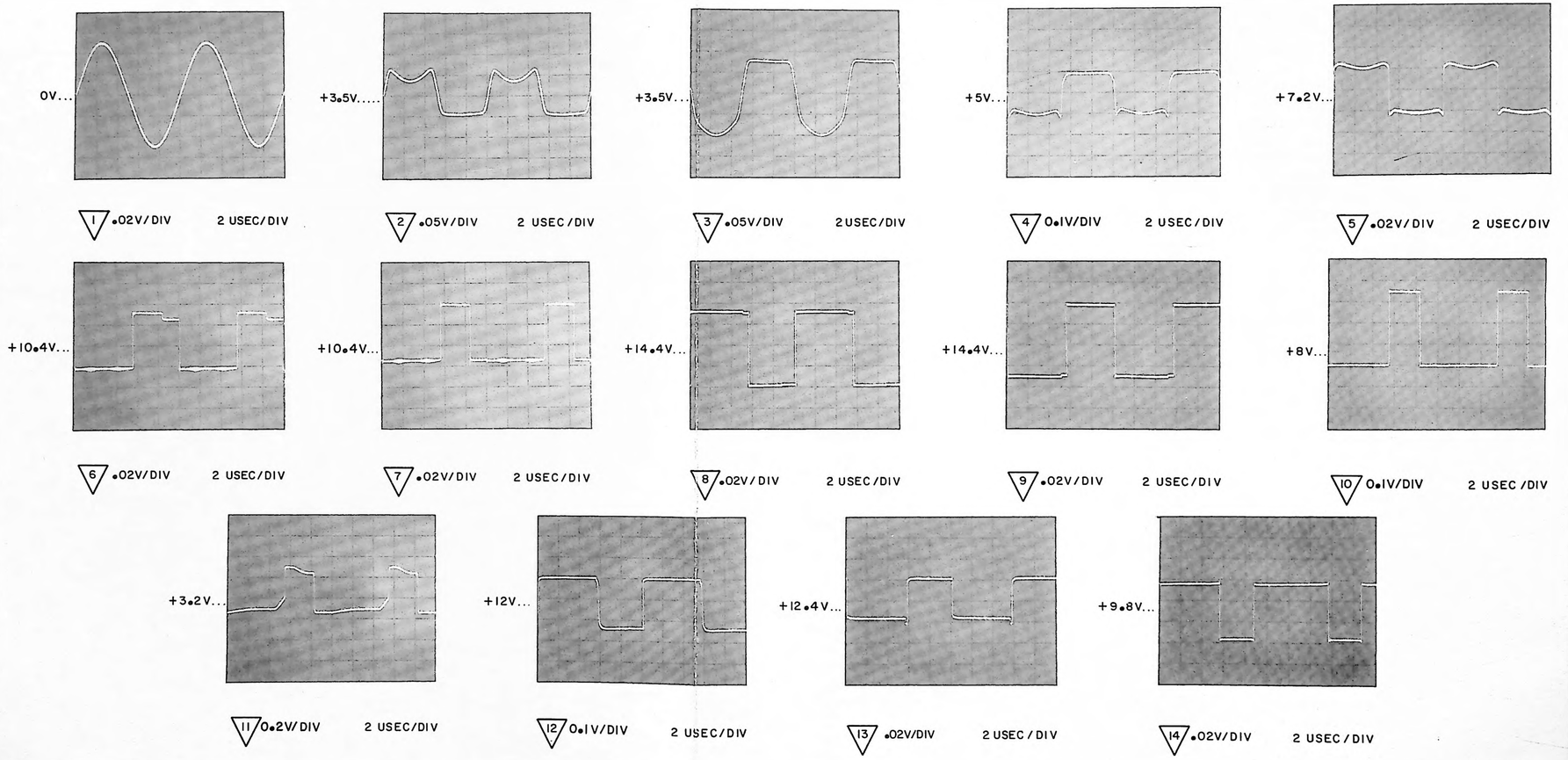



side of the board.

| G | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | G-2 | R101 | L-3 | R120 | I-5 | R139 | K-5 | R158 | D-5 | TP8 | D-4 |
| | H-2 | R102 | L-4 | R121 | I-5 | R140 | K-5 | R159 | D-3 | TP9 | G-3 |
| | H-3 | R103 | K-4 | R122 | H-4 | R141 | J-5 | R160 | G-2 | TP10 | G-4 |
| | I-4 | R104 | L-3 | R123 | H-5 | R142 | K-4 | R161 | H-3 | TP11 | A-3 |
| | H-3 | R105 | K-2 | R124 | I-4 | R143 | I-2 | R163 | H-2 | TP12 | A-3 |
| | I-3 | R106 | J-5 | R125 | I-4 | R144 | I-3 | R164 | K-5 | TP13 | I-3 |
| | I-3 | R107 | J-5 | R126 | F-2 | R145 | G-4 | R165 | L-3 | TP14 | J-5 |
| | I-3 | R108 | J-5 | R127 | I-5 | R146 | F-5 | R166 | F-5 | U1 | E-4 |
| | H-3 | R109 | J-5 | R128 | M-5 | R147 | I-4 | R167 | L-3 | U2 | E-3 |
| | J-2 | R110 | J-4 | R129 | L-5 | R148 | F-2 | R168 | K-2 | U3 | E-4 |
| | J-3 | R111 | J-4 | R130 | B-6 | R149 | I-5 | R169 | I-3 | U4 | G-3 |
| | J-3 | R112 | J-5 | R131 | L-5 | R150 | G-5 | R170 | H-5 | VR1 | F-4 |
| | J-3 | R113 | J-4 | R132 | L-5 | R151 | G-5 | TP1 | C-4 | VR2 | H-4 |
| | K-4 | R114 | J-4 | R133 | L-5 | R152 | H-5 | TP2 | D-4 | VR3 | H-4 |
| | L-3 | R115 | K-4 | R134 | L-5 | R153 | G-5 | TP3 | D-4 | VR4 | J-3 |
| | K-2 | R116 | H-5 | R135 | M-5 | R154 | F-2 | TP4 | E-3 | VR5 | I-4 |
| | L-3 | R117 | H-5 | R136 | L-5 | R155 | K-1 | TP5 | E-3 | VR6 | K-4 |
| | K-2 | R118 | H-4 | R137 | K-5 | R156 | G-2 | TP6 | F-3 | VR7 | E-2 |
| 0 | K-2 | R119 | H-5 | R138 | K-5 | R157 | D-5 | TP7 | F-4 | VR8 | E-2 |

1840A-B-1A

Note: Measurement Conditions for these waveforms are in Table 8-2.




1840A-C-4

Figure 8-3. Gate Generator Waveforms

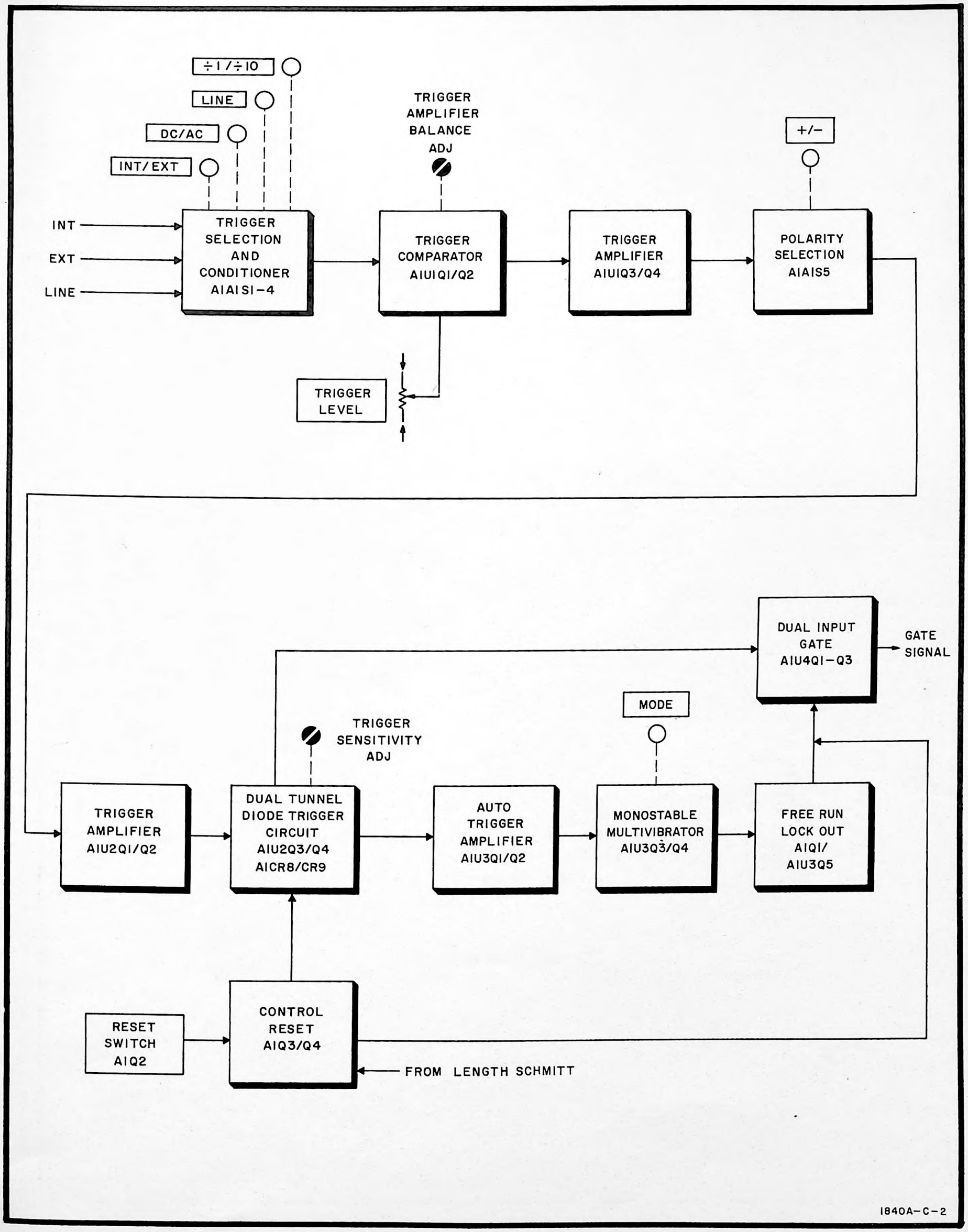
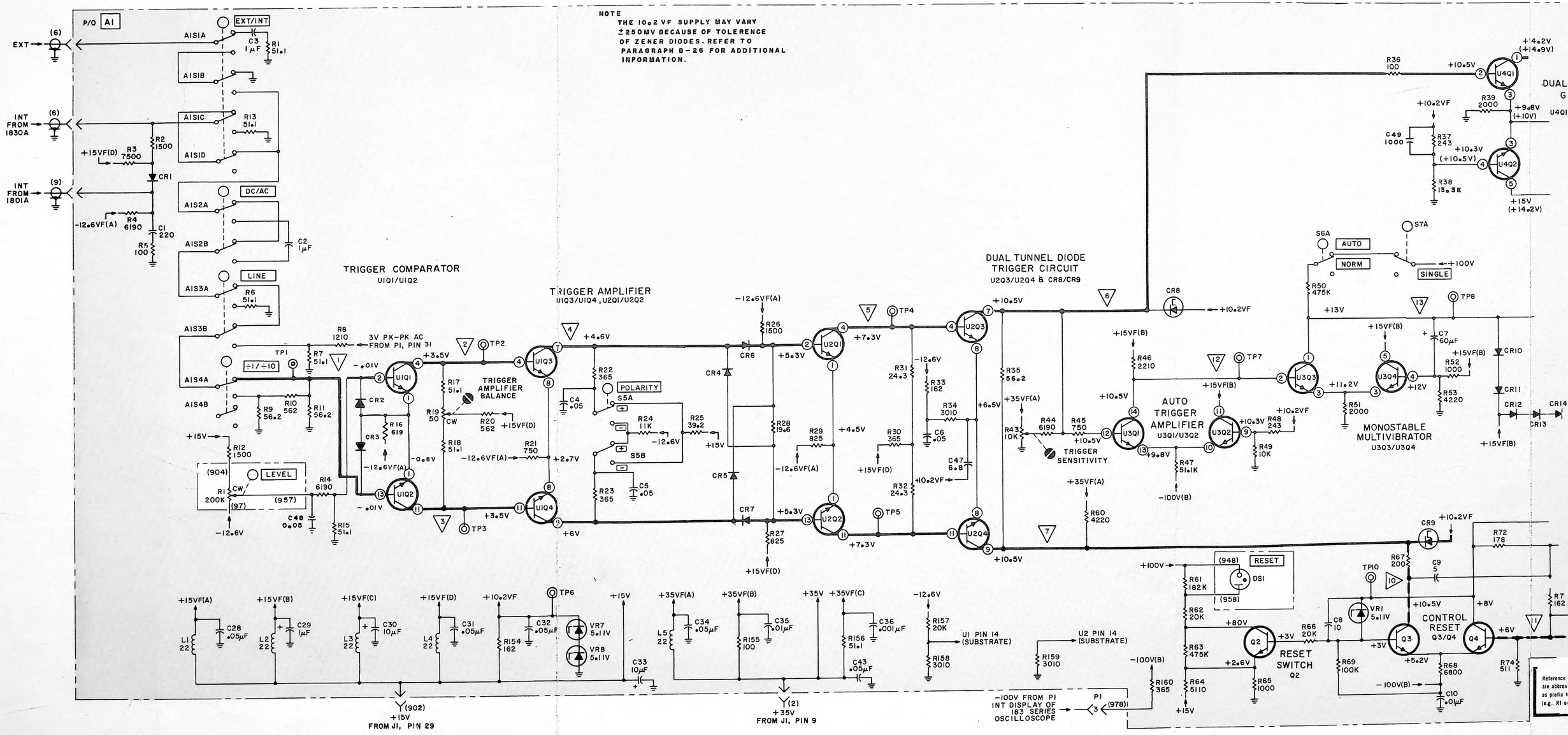
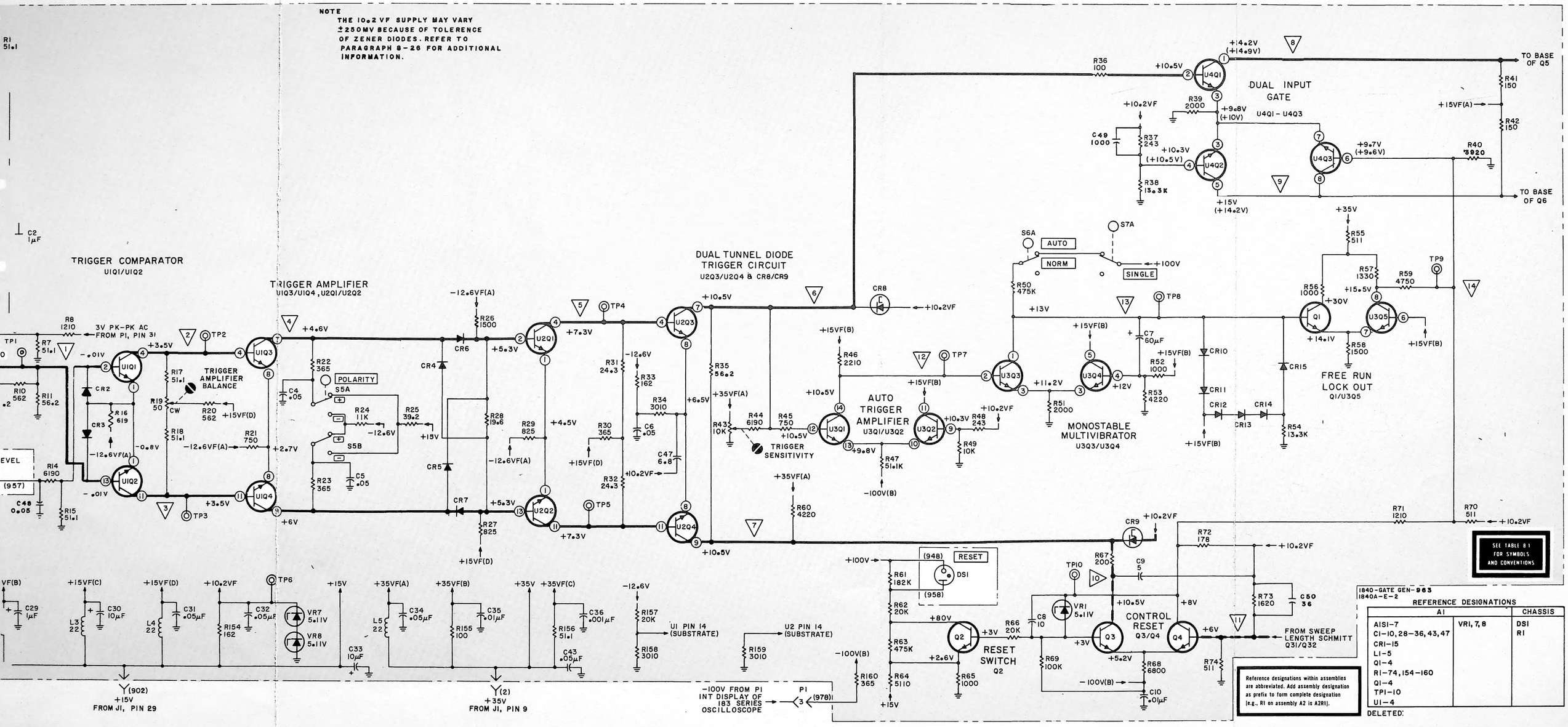



Figure 8-4. Gate Generator Block Diagram


NOTE
THE 10.2 VF SUPPLY MAY VARY ±250MV BECAUSE OF TOLERENCE OF ZENER DIODES. REFER TO PARAGRAPH 6-26 FOR ADDITIONAL INFORMATION.
P/O A1
EXT
INT FROM 1830A
INT FROM 1801A
EXT/INT
DC/AC
LINE
AIS1A
AIS1B
AIS1C
AIS1D
AIS2A
AIS2B
AIS3A
AIS3B
AIS4A
AIS4B
TRIGGER COMPARATOR
U1Q1/U1Q2
TRIGGER AMPLIFIER
U1Q3/U1Q4, U2Q1/U2Q2
TRIGGER AMPLIFIER BALANCE
POLARITY
LEVEL
÷1/÷10
3V PK-PK AC FROM P1, PIN 31
DUAL TUNNEL DIODE TRIGGER CIRCUIT
U2Q3/U2Q4 & CR8/CR9
AUTO
NORM
SINGLE
AUTO TRIGGER AMPLIFIER
U3Q1/U3Q2
TRIGGER SENSITIVITY
MONOSTABLE MULTIVIBRATOR
U3Q3/U3Q4
RESET
CONTROL RESET
Q3/Q4
RESET SWITCH
Q2
-100V FROM P1 INT DISPLAY OF 183 SERIES OSCILLOSCOPE
+15V FROM J1, PIN 29
+35V FROM J1, PIN 9
U1 PIN 14 (SUBSTRATE)
U2 PIN 14 (SUBSTRATE)




1840-GATE GEN-963
1840A-E-2

REFERENCE DESIGNATIONS

| A1 | | CHASSIS |
|---|---|---|
| A1SI-7 | VR1, 7, 8 | DS1 |
| C1-10, 28-36, 43, 47 | | R1 |
| CR1-15 | | |
| L1-5 | | |
| Q1-4 | | |
| R1-74, 154-160 | | |
| Q1-4 | | |
| TP1-10 | | |
| U1-4 | | |

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Figure 8-5. Gate Generator Schematic

Note: Measurement Conditions for these waveforms are in Table 8-2.

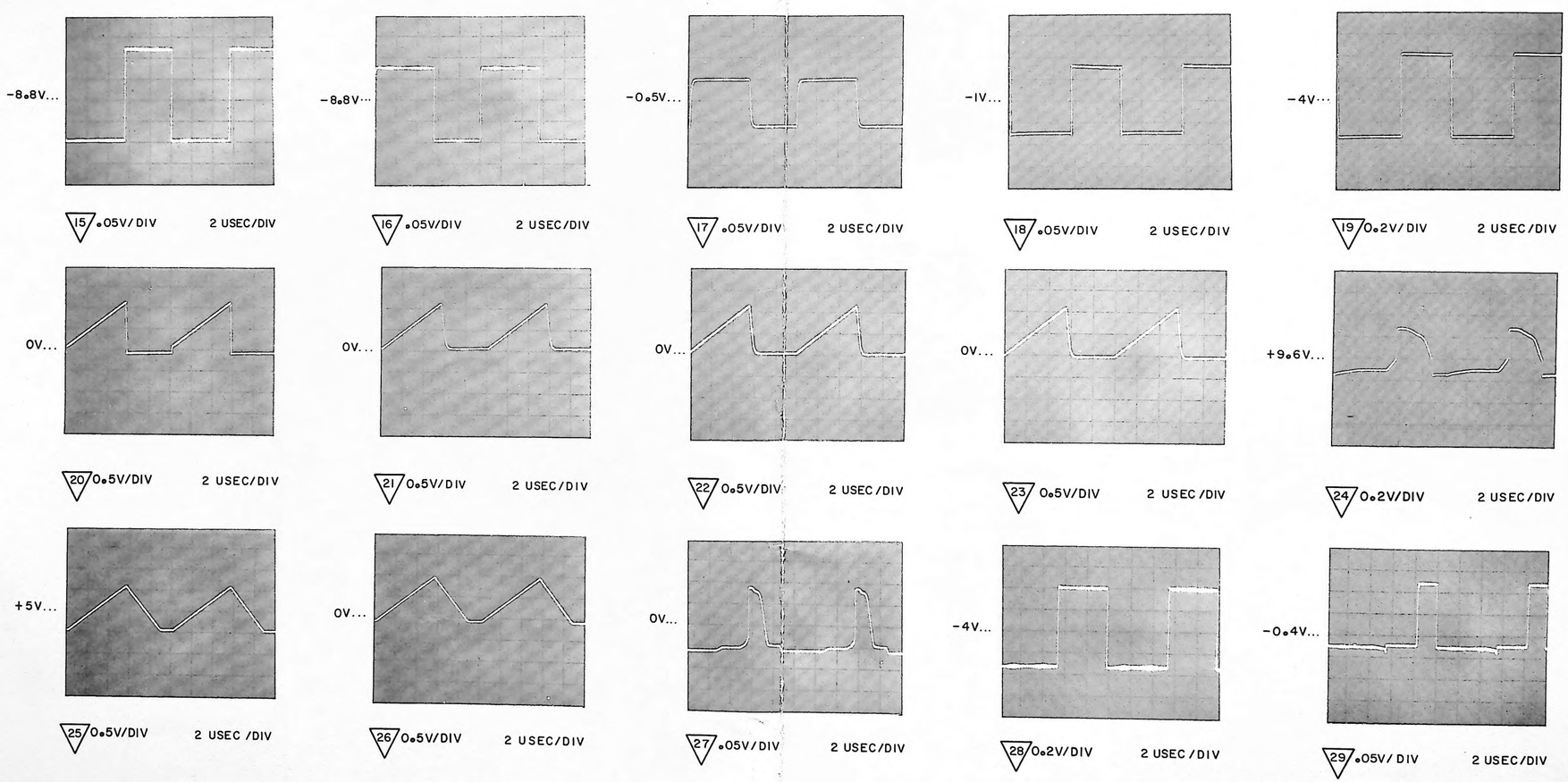



Figure 8-6. Sweep Generator Waveforms

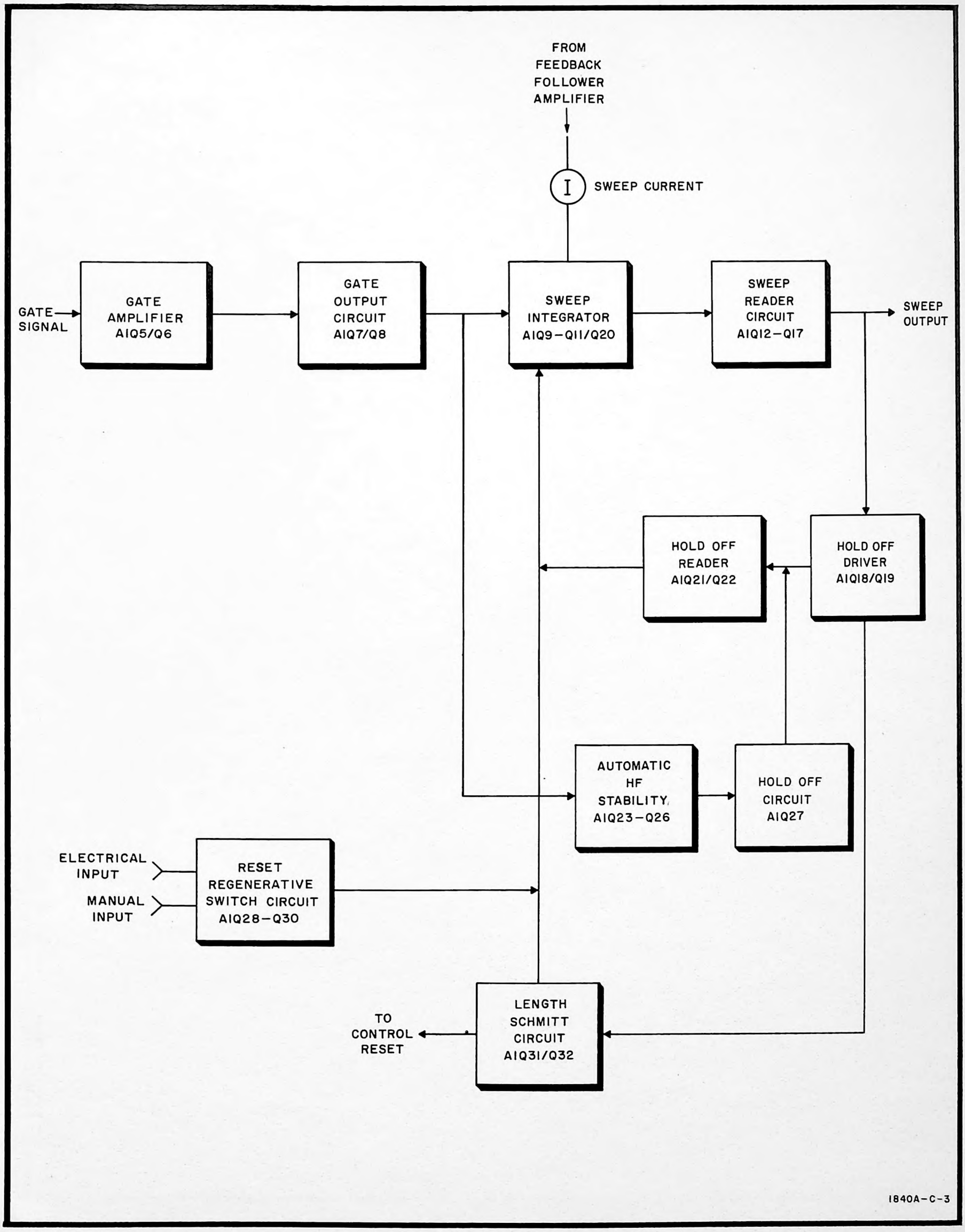
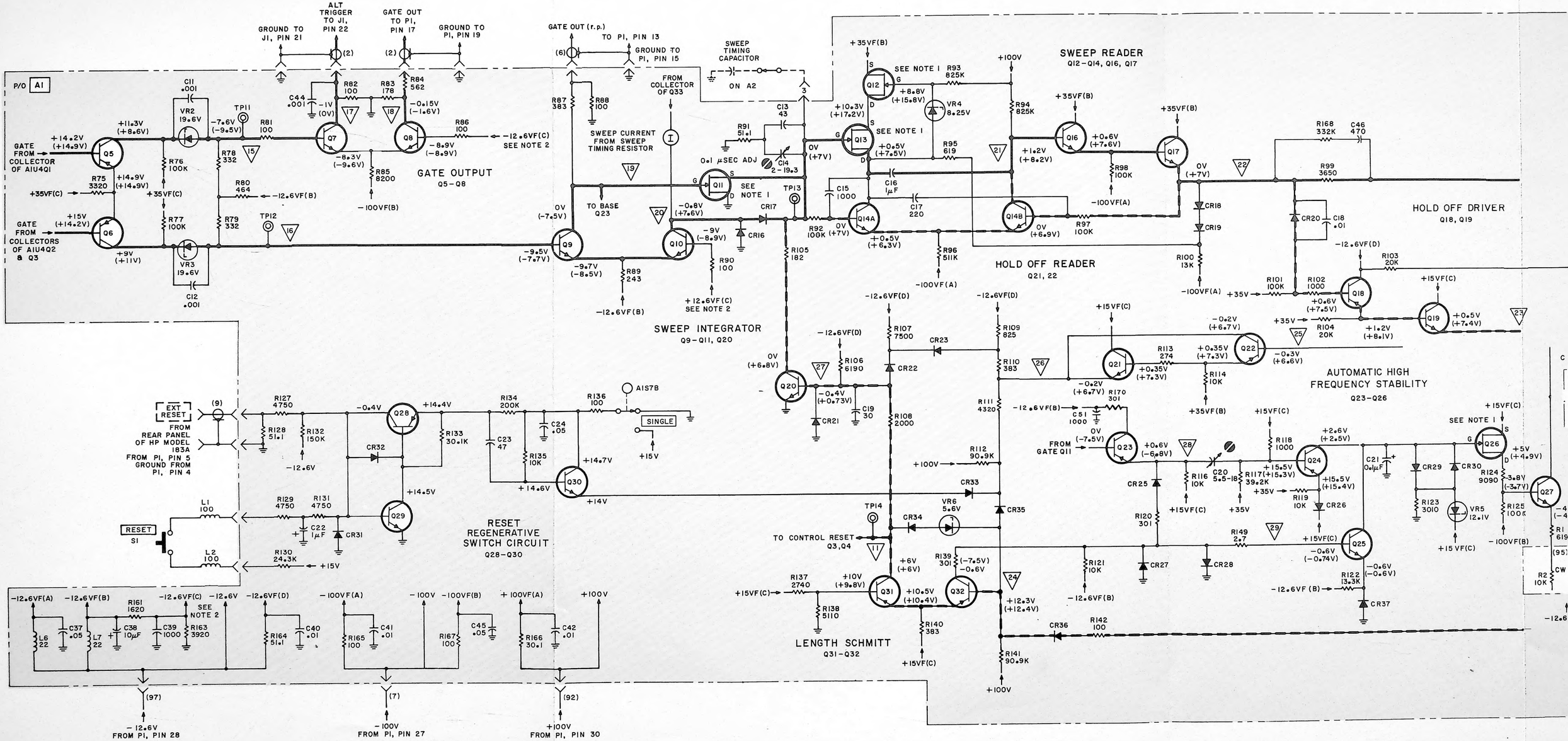
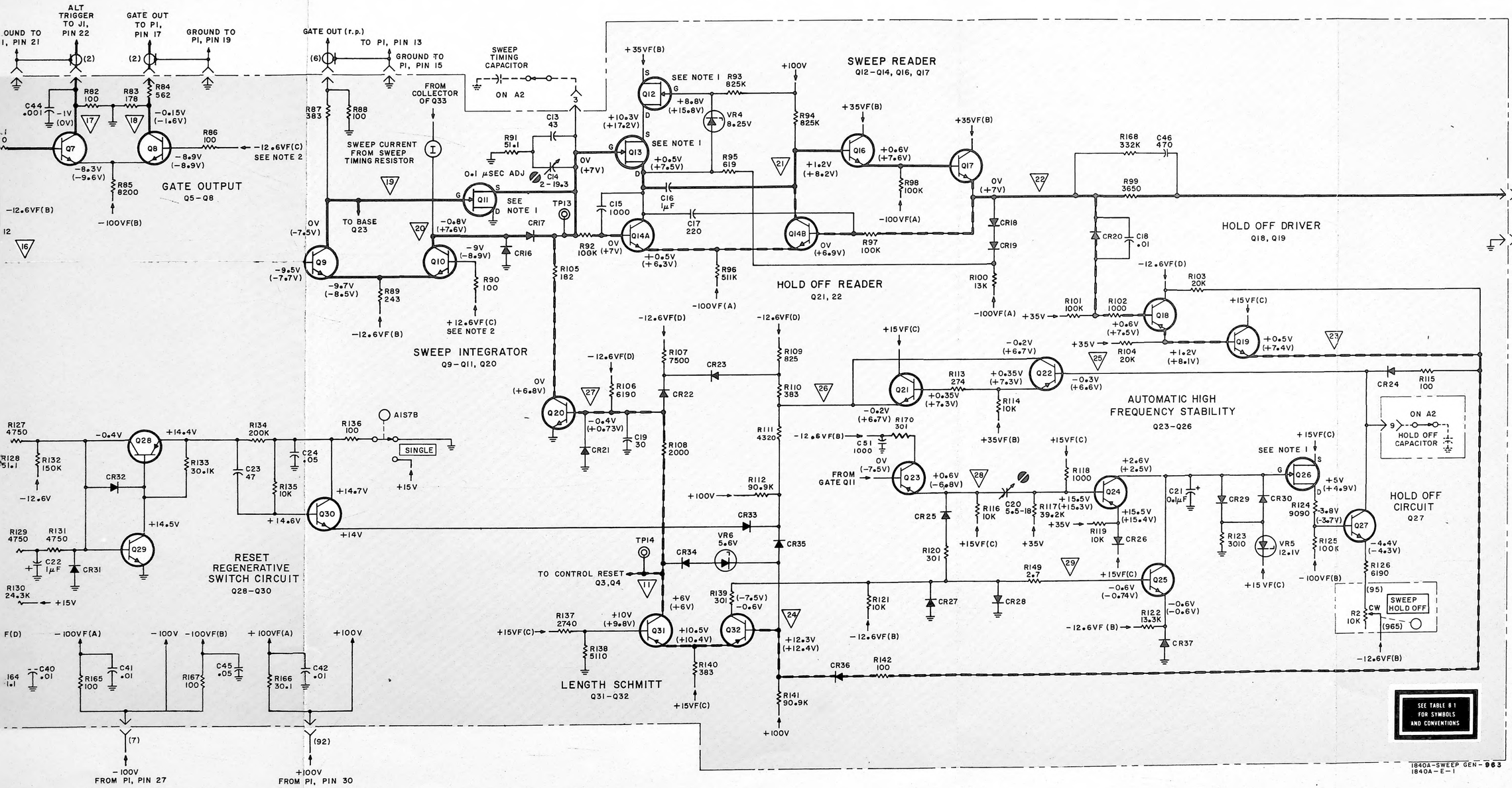



Figure 8-7. Sweep Generator Block Diagrams


P/O A1
GROUND TO J1, PIN 21
ALT TRIGGER TO J1, PIN 22
GATE OUT TO P1, PIN 17
GROUND TO P1, PIN 19
GATE OUT (r.p.)
TO P1, PIN 13
GROUND TO P1, PIN 15
SWEEP TIMING CAPACITOR
ON A2
FROM COLLECTOR OF Q33
SWEEP CURRENT FROM SWEEP TIMING RESISTOR
GATE FROM COLLECTOR OF A1U4Q1
GATE FROM COLLECTORS OF A1U4Q2 & Q3
GATE OUTPUT
Q5-Q8
SEE NOTE 2
TO BASE Q23
SWEEP INTEGRATOR
Q9-Q11, Q20
0.1 μSEC ADJ
SEE NOTE 1
SWEEP READER
Q12-Q14, Q16, Q17
HOLD OFF DRIVER
Q18, Q19
HOLD OFF READER
Q21, 22
AUTOMATIC HIGH FREQUENCY STABILITY
Q23-Q26
EXT RESET
FROM REAR PANEL OF HP MODEL 183A
FROM P1, PIN 5
GROUND FROM P1, PIN 4
SINGLE
RESET REGENERATIVE SWITCH CIRCUIT
Q28-Q30
TO CONTROL RESET Q3,Q4
LENGTH SCHMITT
Q31-Q32
FROM P1, PIN 28
FROM P1, PIN 27
FROM P1, PIN 30




NOTE 1:

REFER TO TROUBLESHOOTING, SECTION VIII, FOR FET'S DESIGNATION EXPLANATION. THESE FET'S ARE LABELED ACCORDING TO MANUFACTURER'S DESIGNATIONS.

NOTE 2:

THE -12.6VF(C) IS APPROXIMATELY -9V BECAUSE OF THE DROPPING RESISTORS R161 AND R163.

REFERENCE DESIGNATIONS

| AI | CHASSIS |
|---|---|
| AIS7 | L1, 2 |
| C11-24, 37-42, 44-46 | R2 |
| CR16-37 | S1 |
| L6, 7 | |
| Q5-14, 16-32 | |
| R75-142, 149, 161, 163-168 | |
| TP11-14 | |
| VR2-6 | |

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Reference designations within assemblies are abbreviated. Add assembly designation as prefix to form complete designation (e.g., R1 on assembly A2 is A2R1).

Figure 8-8. Sweep Generator Schematic

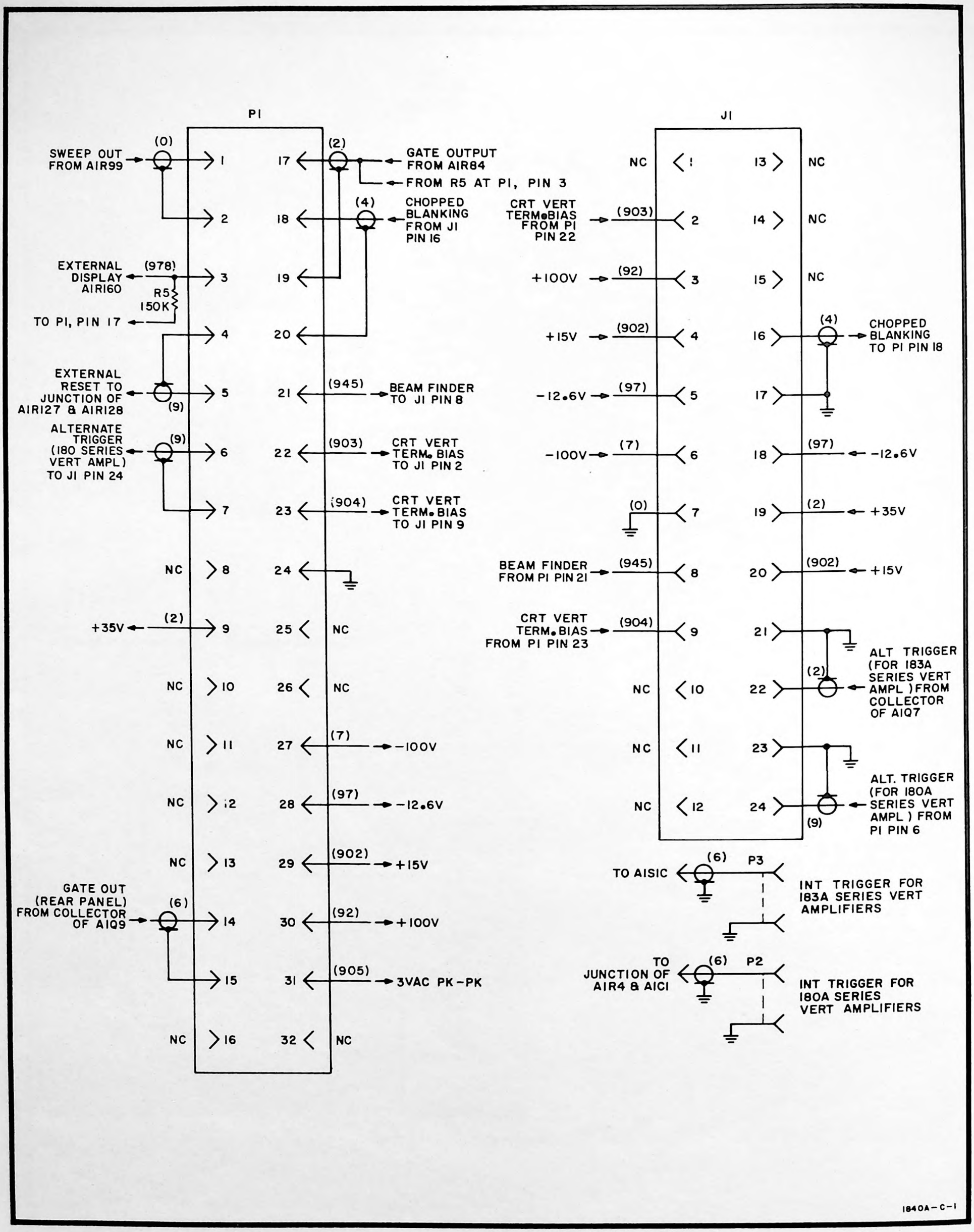



Figure 8-9. Plug and Jack Connections

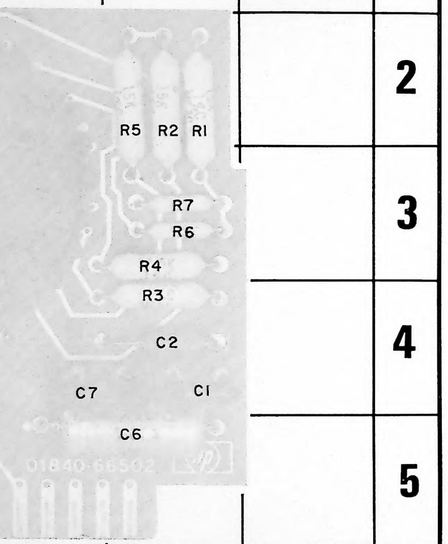
Note: Printed circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|
| C1 | E-4 | R1 | E-2 |
| C2 | E-4 | R2 | E-2 |
| C3 | B-3 | R3 | E-4 |
| C4 | A-4 | R4 | E-3 |
| C5 | B-4 | R5 | E-2 |
| C6 | E-5 | R6 | E-3 |
| C7 | D-4 | R7 | E-3 |
| C8 | B-4 | R8 | A-4 |
| | | S1 | C-2 |

1840A-A-7

Figure 8-10. A2 Component Locations

| D | E | F | |
|---|---|---|---|
| | | | 1 |
| | | | 2 |
| | | | 3 |
| | | | 4 |
| | | | 5 |
| | | | 6 |




d through component holes.
er side of the board.

| F IG | GRID LOC |
|---|---|
| | E-2 |
| | E-2 |
| | E-4 |
| | E-3 |
| | E-2 |
| | E-3 |
| | E-3 |
| | A-4 |
| | C-2 |

1840A-A-7

ponent Locations

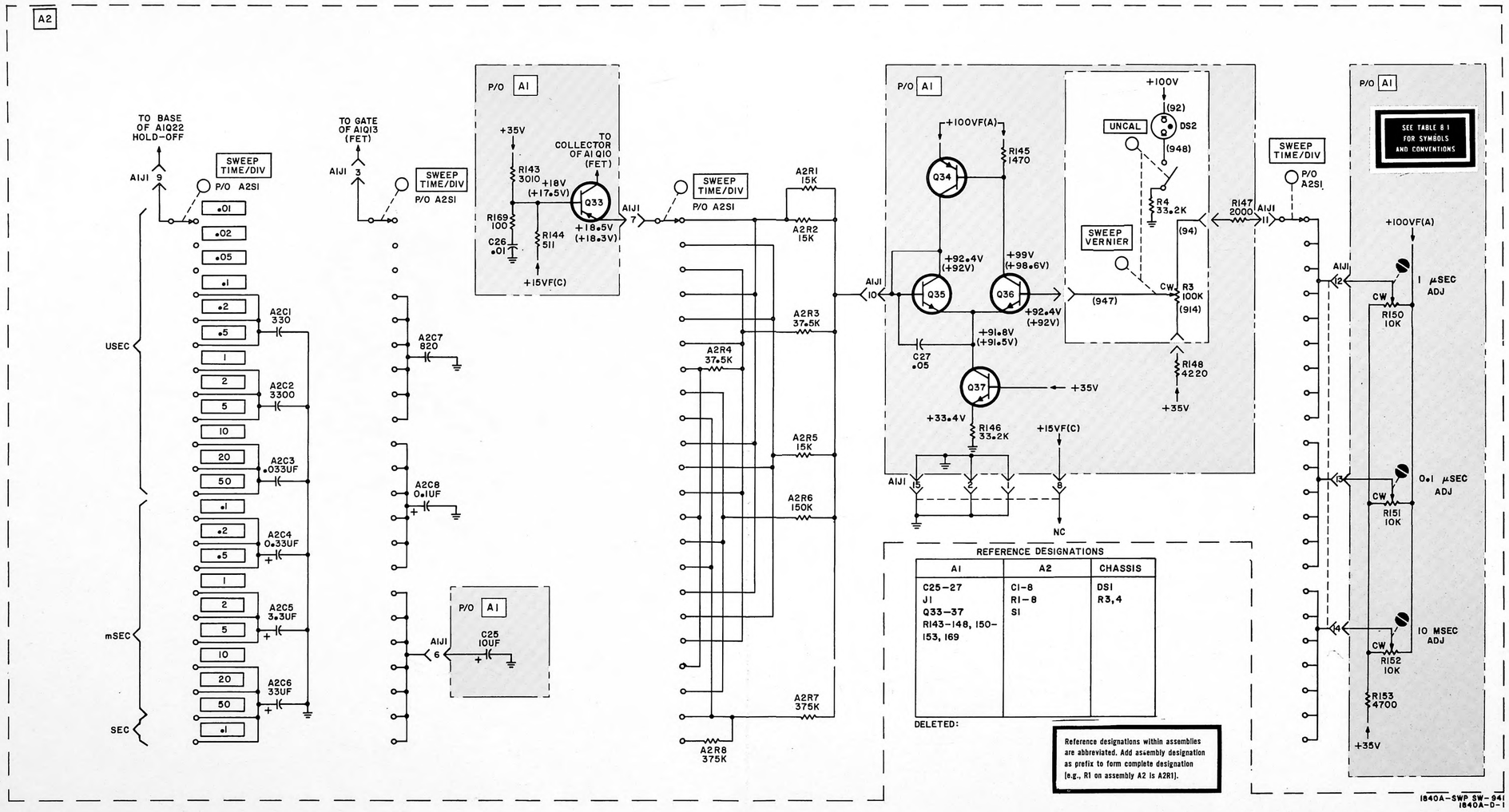



Figure 8-11. Sweep Time Switch and Sweep Current Source Schematic
8-9/8-10

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B-1170 **Brussels**
Tel: (03/02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

**NETHERLANDS**
Hewlett-Packard Benelux, N.V.
Weerdestein 117
P.O. Box 7825
**Amsterdam**, Z 11
Tel: 020-42 77 77
Cable: PALOBEN Amsterdam
Telex: 13 216 hepa nl

**NORWAY**
Hewlett-Packard Norge A/S
Box 149
Nesveien 13
N-1344 **Haslum**
Tel: (02)-53 83 60
Telex: 16621

**PORTUGAL**
Telectra-Empresa Tecnica de Equipamentos
Electricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-**Lisbon** 1
Tel: (19) 68 60 72
Cable: TELECTRA Lisbon
Telex: 1598

**SPAIN**
Hewlett-Packard Española, S.A.
Jerez No 8
**Madrid** 16
Tel: 458 26 00
Telex: 23515 hpe

Hewlett-Packard Española, S.A.
Milanesado 21-23
E-**Barcelona** 17
Tel: (3) 203 62 00

**SWEDEN**
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-161 20 **Bromma** 20
Tel: (08) 98 12 50
Cable: MEASUREMENTS Stockholm
Telex: 10721

Hewlett-Packard Sverige AB
Hagakersgatan 9C
S-431 41 **Mölndal**
Tel: (031) 27 68 00/01
Telex: 21 312 hpmindl s

**SWITZERLAND**
Hewlett Packard (Schweiz) AG
Zürcherstrasse 20
P.O. Box 64
CH-8952 **Schlieren** Zurich
Tel: (01) 98 18 21/24
Cable: HPAG CH
Telex: 53933

Hewlett-Packard (Schweiz) AG
Rue du Bois-du-Lan 7
P.O. Box 85
1217 Meyrin 2 **Geneva**
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 27333 hpsa ch

**TURKEY**
Telekom Engineering Bureau
P.O. Box 376
Karaköy
**Istanbul**
Tel: 49 40 40
Cable: TELEMATION Istanbul

**UNITED KINGDOM**
Hewlett-Packard Ltd.
224 Bath Road
**Slough**, SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
**Altrincham**, Cheshire
Tel: (061) 928-8626
Telex: 668068

**SOCIALIST COUNTRIES PLEASE CONTACT:**
Hewlett-Packard Ges.m.b.H
Innstrasse 23/2
Postfach 45
A-1204 **Vienna**, Austria
Tel: (0222) 33 66 06-09
Cable: HEWPACK Vienna
Telex: 75923 hewpak a

**ALL OTHER EUROPEAN COUNTRIES CONTACT:**
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
P.O. Box 85
CH-1217 Meyrin **2 Geneva**
Switzerland
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2.24.86

# AFRICA, ASIA, AUSTRALIA

**ANGOLA**
Telectra Empresa Técnia de Equipamentos Eléctricos SAR
Rua de Barbosa Rodrigues 42-1°
Box 6487
**Luanda**
Cable: TELECTRA Luanda

**AUSTRALIA**
Hewlett-Packard Australia Pty. Ltd.
22-26 Weir Street
**Glen Iris**, 3146
Victoria
Tel: 20-1371 (6 lines)
Cable: HEWPARD Melbourne
Telex: 31 024

Hewlett-Packard Australia Pty. Ltd.
61 Alexander Street
**Crows Nest** 2065
New South Wales
Tel: 43-7866
Cable: HEWPARD Sydney
Telex: 21561

Hewlett-Packard Australia Pty. Ltd.
97 Churchill Road
**Prospect** 5082
South Australia
Tel: 65-2366
Cable: HEWPARD Adelaide

Hewlett Packard Australia Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
**Perth**, W.A. 6000
Tel: 21-3330
Cable: HEWPARD Perth

Hewlett-Packard Australia Pty. Ltd.
10 Woolley Street
P.O. Box 191
**Dickson A.C.T.** 2602
Tel: 49-8194
Cable: HEWPARD Canberra ACT

Hewlett-Packard Australia Pty. Ltd.
6 Harvard Street
P.O. Box 135
**Kenmore** 4069 Queensland
Tel: 70-4050

**CEYLON**
United Electricals Ltd.
P.O. Box 681
Yahala Building
Staples Street
**Colombo** 2
Tel: 5496
Cable: HOTPOINT Colombo

**CYPRUS**
Kypronics
19 Gregorios & Xenopoulos Road
P.O. Box 1152
**Nicosia**
Tel: 6282-75628
Cable: HE-I-NAMI

**ETHIOPIA**
African Salespower & Agency Private Ltd., Co.
P. O. Box 718
58/59 Cunningham St.
**Addis Ababa**
Tel: 12285
Cable: ASACO Addisababa

**HONG KONG**
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511, Prince's Building 15th Floor
10, Chater Road
**Hong Kong**
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

**INDIA**
Blue Star Ltd.
Kasturi Buildings
Jamshedji Tata Rd.
**Bombay** 20BR, India
Tel: 29 50 21
Telex: 3751
Cable: BLUEFROST

Blue Star Ltd.
Band Box House
Prabhadevi
**Bombay** 25DD, India
Tel: 45 73 01
Telex: 3751
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
**Kanpur**, India
Tel: 6 88 82
Cable: BLUESTAR

Blue Star, Ltd.
7 Hare Street
P.O. Box 506
**Calcutta** 1, India
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House,
34 Ring Road
Lajpat Nagar
**New Delhi** 24, India
Tel: 62 32 76
Telex: 463
Cable: BLUESTAR

Blue Star, Ltd.
Blue Star House
11/11A Magarath Road
**Bangalore**, 25
Tel: 51473
Telex: 430
Cable: BLUESTAR

Blue Star, Ltd.
1-1-117/1
Sarojini Devi Road
**Secunderabad** 3
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST

Blue Star, Ltd.
23/24 Second Line Beach
**Madras** 1, India
Tel: 2 39 55
Telex: 379
Cable: BLUESTAR

Blue Star, Ltd.
1B Kaiser Bungalow
Dindli Road
**Jamshedpur**, India
Tel: 38 04
Cable: BLUESTAR

**INDONESIA**
Bah Bolon Trading Coy. N.V.
Djalah Merdeka 29
**Bandung**
Tel: 4915; 51560
Cable: ILMU
Telex: 08-809

**IRAN**
Multicorp International Ltd.
Avenue Soraya 130
P.O. Box 1212
**Teheran**
Tel: 83 10 35-39
Cable: MULTICORP Tehran
Telex: 2876 service tn

**ISRAEL**
Electronics & Engineering Div. of Motorola Israel Ltd.
17 Aminadav Street
**Tel-Aviv**
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: MOTIL IL

**JAPAN**
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku, **Tokyo**
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
**Osaka**
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA

Yokogawa-Hewlett-Packard Ltd.
Ito Building
No. 59, Kotori-cho
Nakamura-ku, **Nagoya** City
Tel: (052) 551-0215

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2-4-2 Shinohara-Kita
Kohoku-ku
**Yokohama** 222
Tel: 045-432-1504
Telex: 382-3204 YHP YOK

**JORDAN**
Constantin E. Macridis
Clemenceau Street
P.O. Box 7213
**Beirut**, Lebanon
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

**KENYA**
Kenya Kinetics
P.O. Box 18311
**Nairobi**, Kenya
Tel: 57726
Cable: PROTON

**KOREA**
Amtraco Corporation
Industrial Products Div.
Seoul P.O. Box 1103
8th floor, DaeKyung Bldg.
107 Sejong Ro
Chongro-Ku, Seoul
Tel: 73-8924-7
Cable: AMTRACO Seoul

**LEBANON**
Constantin E. Macridis
Clemenceau Street
P.O. Box 7213
**Beirut**
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

**MALAYSIA**
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, Selangor
Cable: MECOMB Kuala Lumpur

**MOZAMBIQUE**
A. N. Goncalves, LDA.
4.1 Apt. 14 Av. D. Luis
P.O. Box 107
**Lourenco Marques**
Cable: NEGON

**NEW ZEALAND**
Hewlett-Packard (N.Z.) Ltd.
94-96 Dixson St.
P.O. Box 9443
**Wellington, N.Z.**
Tel: 56-559
Cable: HEWPACK Wellington

Hewlett Packard (N.Z.) Ltd.
Box 51092
**Pukuranga**
Tel: 56-9837
Cable: HEWPACK, Auckland

**PAKISTAN**
Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
**Karachi** 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
38B, Satellite Town
**Rawalpindi**
Tel: 41924
Cable: FEMUS Rawalpindi

**PHILIPPINES**
Electromex Inc.
5th Floor, Architects Center Bldg.
Ayala Ave., Makati, Rizal
C.C.P.O. Box 1028
**Makati**, Rizal
Tel: 86-18-87, 87-76-77
Cable: ELEMEX Manila

**SINGAPORE**
Mechanical and Combustion Engineering Company Ltd.
9, Jalan Kilang
Red Hill Industrial Estate
**Singapore**, 3
Tel: 642361-3; 632611
Cable: MECOMB Singapore

Hewlett-Packard Far East Area Office
P.O. Box 87
Alexandra Post Office
**Singapore** 3
Tel: 633022
Cable: HEWPACK SINGAPORE

**SOUTH AFRICA**
Hewlett Packard South Africa (Pty.), Ltd.
P.O. Box 31716
Braamfontein Transvaal
Milnerton
30 De Beer Street
**Johannesburg**
Tel: 725-2080, 725-2030
Telex: 0226 JH
Cable: HEWPACK Johannesburg

Hewlett Packard South Africa (Pty.), Ltd.
Breecastle House
Bree Street
**Cape Town**
Tel: 3-6019, 3-6545
Cable: HEWPACK Cape Town
Telex: 5-0006

Hewlett Packard South Africa (Pty.), Ltd.
641 Ridge Road, Durban
P.O. Box 99
**Overport**, Natal
Tel: 88-6102
Telex: 567954
Cable: HEWPACK

**TAIWAN**
Hewlett Packard Taiwan
39 Chung Shiao West Road
Sec. 1
Overseas Insurance Corp. Bldg. 7th Floor
**Taipei**
Tel: 389160,1,2, 375121, Ext. 240-249
Telex: TP824 HEWPACK
Cable: HEWPACK Taipei

**THAILAND**
UNIMESA Co., Ltd.
Chongkoinee Building
56 Suriwongse Road
**Bangkok**
Tel: 37956, 31300, 31307, 37540
Cable: UNIMESA Bangkok

**UGANDA**
Uganda Tele-Electric Co., Ltd.
P.O. Box 4449
**Kampala**
Tel: 57279
Cable: COMCO Kampala

**VIETNAM**
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
**Saigon**
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

**ZAMBIA**
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
**Lusaka**
Zambia, Central Africa
Tel: 73793
Cable: ARJAYTEE, Lusaka

**MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:**
Hewlett-Packard
Co-ordination Office for Mediterranean and Middle East Operations
Via Marocco, 7
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPACKIT Rome
Telex: 61514

**OTHER AREAS NOT LISTED, CONTACT:**
Hewlett-Packard
INTERCONTINENTAL
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

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